

135592

ATTACHMENT A
(Sheet 7 of 7)
FT-11.04, REV. 0

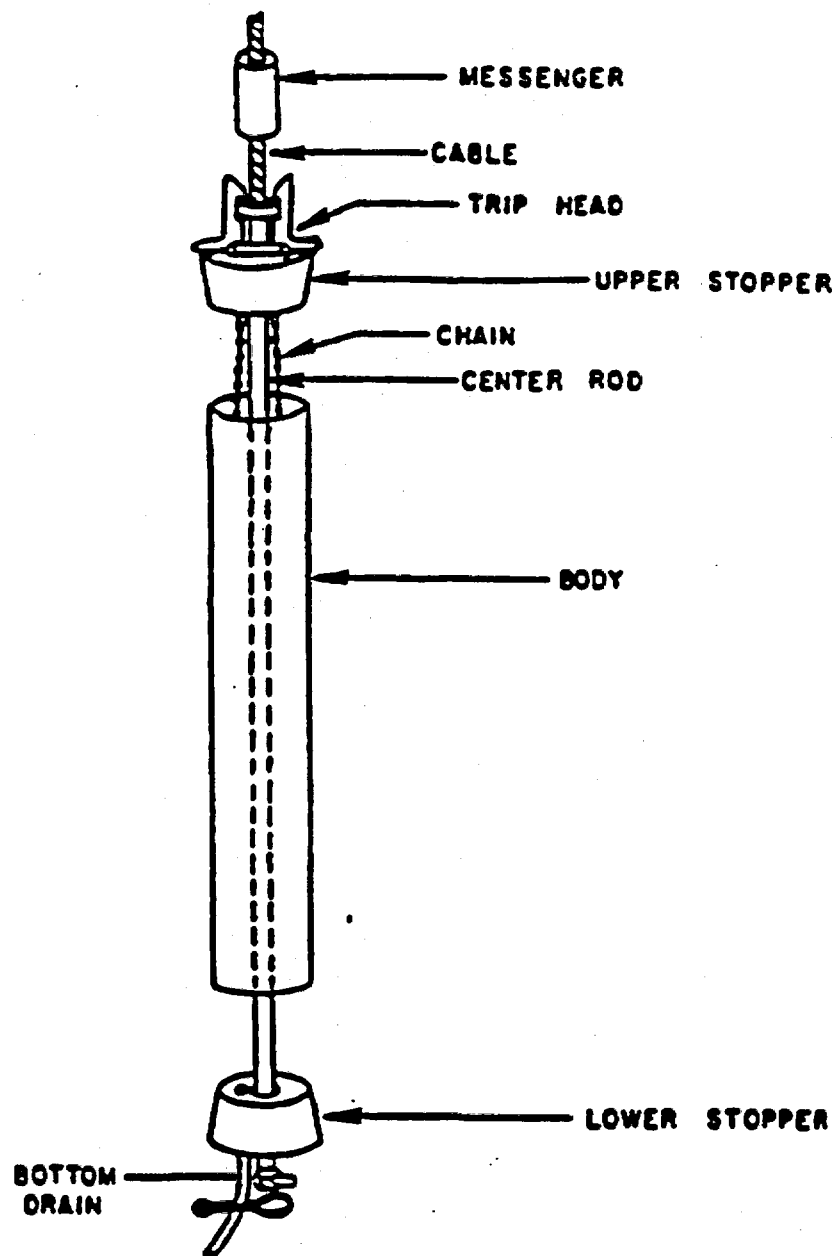


FIGURE A-3. MODIFIED KEMMERER SAMPLER

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COLLECTION OF LIQUID CONTAINERIZED WASTES USING GLASS TUBE

Description

Liquid samples from opened containers are collected using lengths of glass tubing. The glass tubes are normally 122 cm in length and 6 to 16 mm inside diameter. Longer tubes may be used but larger diameter tubing is not effective. The tubing allows inspection of the tank contents for stratification. This method should not be attempted with less than a two-person sampling team.

Uses

This method provides for a quick, relatively inexpensive means of collecting concentrated containerized wastes. The major disadvantage is from potential sample loss, which is especially prevalent when sampling low viscosity fluids. Splashing can also be a problem, and proper protective clothing should always be worn.

Sampling Method

1. Remove cover from sample container opening.
2. Insert glass tubing almost to the bottom of the container. Try to keep at least 30cm of tubing above the top of the container.
3. Allow the waste in the tank to reach its natural level in the tube, then cap the top of the tube with a rubber stopper.
4. Carefully remove the capped tube from the tank and insert the uncapped end in the sample container.
5. Release the thumb or stopper on the tube and allow the sample container to fill to approximately 90 percent of its capacity.
6. Repeat steps 2 through 6 if more volume is needed to fill the sample container.
7. Cap the sample container tightly with a Teflon-lined cap and affix the label and sample identification tag (see guideline FT-7.05).

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Responsibilities for filling out individual reports are identified within the description of the reports (see below).

5.0 GUIDELINES

5.1 GENERAL

The primary means of recording onsite activities is the site logbook (see Guideline FT-13.03) and other field logbooks (e.g. geologists notebook, health and safety officer's logbook, sample logbooks). However, these logbooks and notebooks usually contain extremely detailed information which is required for data interpretation or documentation, but not for tracking and reporting of progress. Furthermore, the field logbooks remain onsite for extended periods of time and are thus not accessible for review by project management. The reports described in this guideline are, in essence, simplified summaries of the logbooks, which are designed to provide only the information needed by project management to keep informed of the progress of field activities. These reports (and their frequency) are listed in Attachment A.

5.2 RIG SHIFT REPORT

5.2.1 Description

The Rig Shift Report documents the activities and progress at a specific drilling location. This report is filled out whenever there are drilling activities (daily, or more frequently if more than one shift per day).

The front of this report (Attachment B-1) documents the drilling subcontractor's activities, with hours spent at a particular task recorded to verify billing and to record progress.

All materials used are also recorded for billing verification. A blank area is provided for later verification of materials specifications/quantities/prices.

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~~The back of this report (Attachment B-2) records work progress, i.e. number of feet drilled, samples collected, etc., along with any comments. Also, the pages in the geologist's logbooks containing more detailed information about the drilling/sampling activities are cross-referenced with the rig shift report.~~

5.2.2 Responsibilities

It is the responsibility of the rig geologist to complete the rig shift report and review the driller's daily report to verify that the times and quantities of material entered in the drillers report are correct and match the rig shift report.

5.2.3 Submittal and Approval

At the end of the shift, the rig geologist submits the rig shift report to the Field Operations Leader (FOL) for review and filing. The Rig Shift Report is not a formal report and thus requires no further approval. The reports are retained by the FOL for use in preparing the site logbook (see FT-13.03) and Weekly Field Summaries, and are submitted to the Site Manager weekly along with the Weekly Field Summary.

5.3 WEEKLY FIELD SUMMARY

5.3.1 Description

The Weekly Field Summary is an abstract of the Site Logbook, summarizing the major activities onsite for a particular week (Sunday through Saturday). It should be organized on a day-by-day basis, and contain the following information at a minimum (see Attachment C):

- . date (week ending)
- . personnel onsite (contractor, subcontractors, visitors)
- . weather conditions encountered during the week
- . site activities

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- . list of samples collected (locations, sample numbers, and analyses to be performed)
- . issues impacting progress of the project.

5.3.2 Responsibilities

The Field Operations Leader (FOL) or an onsite individual that the FOL designates (e.g., geophysics team leader, sampling team leader) is responsible for completing the Weekly Field Summary at the end of each week of ongoing site activity, or at the completion of an activity (if no further activity will take place during that week).

5.3.3 Submittal and Approval

The summary, along with Rig Shift Reports, Health & Safety Officer's Reports, and any other documentation, must be delivered or sent to the Site Manager at the end of each week.

6.0 REFERENCES

1. Guideline FT-13.02 - Forms Used in RI Activities
2. Guideline FT-2.06 - Legal Considerations
3. Guideline CS-3 - Monthly Progress Reporting
4. Guideline FT-13.03 - Site Logbook

7.0 ATTACHMENTS

Attachment A - Periodic Reports Required During a RI/FS

Attachment B-1 - Rig Shift Report (Front)

Attachment B-2 - Rig Shift Report (Back)

Attachment C - Weekly Field Summary Report

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RIG SHIFT REPORT

SITE NAME _____ DATE _____ DRILLING CONTRACTOR _____
PROJECT NO. _____ GEOLOGIST _____ RIG NO. _____
SITE LOCATION _____ H/S TECHNICIAN _____ DRILLER _____
H/S LEVEL _____ HELPER _____

	AM												PM						TOTAL
DRILLERS	5	6	7	8	9	10	11	12	1	2	3	4	5	6	HOURS				
ACTIVITIES																			
MOBILIZATION																			
TRAVEL																			
DRILLING																			
STANDBY																			
BREAK (H/S)																			
BREAK (Other)																			
RIG DOWN TIME																			
DECON																			
OTHER (Specify)																			

* - not chargeable

TOTAL
CHARGEABLE HOURS

MATERIAL USED

Item (Description)

Quantity Used

Not For Use In Field
Check-As Per Spec

Reviewed/Approved by:

Geologist

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SHIFT ACCOMPLISHMENTS

HOLE NO						
DEPTH	START					
	END					
BORING LOG #						
SAMPLE #						
DEPTH						
SAMPLE #						
DEPTH						
SAMPLE #						
DEPTH						
SAMPLE #						
DEPTH						

NO. HOLES COMPLETED _____ NO. SAMPLES _____ (Except QA)

NO. FEET DRILLED _____ NO. QA SAMPLES _____

COMMENTS:

GEOLOGISTS LOGBOOK CROSS REFERENCE:

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WEEKLY FIELD SUMMARY REPORT

SUNDAY

Date : _____ Personnel _____

Weather: _____ Onsite _____

Site Activities: _____

MONDAY

Date : _____ Personnel _____

Weather: _____ Onsite _____

Site Activities: _____

TUESDAY

Date : _____ Personnel _____

Weather: _____ Onsite _____

Site Activities: _____

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WEDNESDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

THURSDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

FRIDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

SATURDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

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5.0 GUIDELINES

5.1 SAMPLE COLLECTION, LABELING, SHIPMENT AND REQUEST FOR ANALYSIS

5.1.1 Sample Label

The sample label is a 2- by 4-in. white label with black lettering and an adhesive backing. Attachment B-1 is an example of a REM III sample label. Blank labels may be obtained from ZPMO or the REM III Regional Offices when needed. These labels are required on every sample but are not controlled documents. Guidelines for filling out sample labels are contained in FT-7.05.

5.1.2 Sample Identification Tag

The Sample Identification Tag (Attachment B-2) must be used with samples collected for Contract Laboratory Program (CLP) analysis. The tag is a white, heavy paper label that is attached to the neck of the sample bottle with a string or wire. The Sample Identification Tag is a controlled document, issued by the EPA Regional Offices. Guideline FT-7.05 provides the steps in filling out Sample Identification Tags. Sample Identification Tags are not used in Region II.

5.1.3 Chain-of-Custody Record Form

The Chain-of-Custody Record form accompanies a sample (or group of samples) as it is transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis, whether on-site or off-site. It is a controlled document. Each EPA Region in Zone 1 uses a slightly different Chain-of-Custody form. Attachments B-3 through B-6 illustrate Chain-of-Custody Record forms used by Regions I through IV, respectively. These forms are available from the EPA Regional Offices. Guidelines for filling out Chain-of-Custody Record forms are contained in FT-7.05.

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5.1.4 Chain-of-Custody Seal

Attachment B-7 is an example of a custody seal. The custody seal is a 1 by 3 inch adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. It is used whenever samples are shipped with an accompanying Chain-of-Custody Record form. Guideline FT-7.05 describes the procedure for using chain-of-custody seals.

~~5.1.5 Receipt for Samples Form~~

~~Whenever samples are split with a private party or government agency, a separate Receipt for Samples form (see Attachment B-8) is prepared for those samples and marked to indicate with whom the samples are being split. Guidelines for filling out the Receipt for Samples form are contained in FT-7.05. These forms are controlled documents and can be obtained from ZPMO.~~

~~5.1.6 Analytical Services Request Form~~

~~The Analytical Services Request form notifies ZPMO of all future analytical needs, both for CLP and non-CLP analyses. ZPMO will then schedule and coordinate CLP analyses through the EPA Sample Management Office (SMO), and non-CLP analyses directly with the REM III subcontractor laboratories. This form is not a controlled document, but it is required if laboratory analytical services are requested for a particular work assignment.~~

~~Attachment B-9 shows an Analytical Services Request form. This form should be filled out by the Site Manager after the sampling plan has been accepted by EPA, and the approximate dates of sampling are known. The sequence for requesting analytical services is described in Guideline FT-7.04.~~

~~5.1.7 Bottle Delivery Order (DO) Form~~

~~If CLP analyses are requested, a Delivery Order (DO) form (Attachment B-10) is completed by the Site Manager and submitted to the CLP Sample Bottle Repository upon receipt of an Analytical Services Request form (see 5.1.6), (see Guideline FT-7.04).~~

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5.1.8 Repository Packing List (PL) Form

The Repository Packing List Form (Attachment B-11) is used when a CLP analysis is requested. The Sample Bottle Repository personnel completes the PL form when the requested bottles are shipped. Field personnel may receive a copy of the PL with the sample bottle shipment. The Regional Lab Sample Coordinator may receive this form if they receive shipments of sample bottles. The PL should be retained in the sample log notebook if the shipment is received in the field.

5.1.9 Sample Log Sheet

A Sample Log Sheet is a notebook (3-ring binder) page that is used to record specified types of data while sampling. Attachment B-12 is an example of a Sample Log Sheet. The data recorded on these sheets are useful in describing the waste source and the sample as well as pointing out any problems encountered during sampling. Guidelines for filling out the Sample Log Sheet are contained in FT-7.04. Blank Sample Log Sheets may be obtained from ZPMO or REM III Regional Offices; these forms are not controlled documents.

5.1.10 Sample Log Notebook - Table of Contents

The Table of Contents form is a 3-ring notebook page on which entries are made as the completed Sample Log Sheets are placed in a three-ring binder. Attachment B-13 is an example of the Table of Contents Form. This form facilitates quick reference to the sample log sheets contained in the notebook and remains in the notebook at all times. Blank Table of Contents forms may be obtained from ZPMO or REM III Regional Offices. These forms are not controlled documents.

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5.1.11 Traffic Reports (for CLP Lab Analyses)

A Traffic Report (TR) is a preprinted, prenumbered form that is provided by the EPA Sample Management Office to each Region through the Regional Sample Control Center (RSCC). These forms are obtained from the RSCC as needed for specific work assignments. These forms are part of the EPA sample-tracking system and are used to trace the shipment of samples for CLP laboratory analysis. Presently, these forms are for three types of samples: organics (OTR), inorganics (ITR), and high hazard (HHTR) (see Attachments B-14, B-15 and B-16, respectively). The organics and inorganics forms are used to document and identify the collection of low- and medium- concentration samples for organic and inorganic analysis; the high-hazard form is for high-concentration samples. Guidelines for filling out traffic report forms are contained in FT-7.04.

Traffic reports are controlled documents. The EPA region which provided the Traffic Report Form can be distinguished by the last letter in the traffic report sample number, with A indicating Region I, B for Region II, C for Region III, and D for Region IV. Thus a traffic report sample number AC 6151 would be from Region III.

5.1.12 Traffic Report Label

The Traffic Report Label is a small prenumbered white label with black lettering and an adhesive backing. Attachment B-17 provides examples of several traffic report labels. Traffic Report Labels come attached to the traffic reports. The number which appears on a traffic report label is the same number that appears in the upper right-hand corner of the traffic report. In addition to the number, each label contains a designation as to the type of analysis to be performed (VOA, etc.) or as to preservation of the sample (preserved, unpreserved, etc.). Any unused labels must be returned to the RSCC.

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5.1.13 Special Analytical Services (SAS) Packing List

In addition to routine analytical services (RAS), some special analytical services (SAS) are available through the CLP. These may include quick turnaround or verification analyses, non-priority pollutant analyses, analyses requiring lower detection limits than RAS methods provide, or other specific analyses (e.g., EP toxicity testing). For an "all SAS" type of request (in contrast to "RAS plus SAS," see Guideline FT-7.04), the SAS Packing List (Attachment B-18) is used rather than a traffic report. SAS Packing Lists are provided by the SMO to each region through the RSCC, which provides forms as required. Use of the SAS form is further described in Guideline FT-7.04.

~~5.1.14 Dioxin Shipment Record (DSR)~~

~~The Dioxin Shipment Record (DSR) provides a record for one shipment batch (up to 24 samples) of dioxin samples to a CLP laboratory. Samples are individually numbered using the pre-printed labels provided with the DSR (see Attachment B-19). DSRs are provided by the SMO to each region through the RSCC. DSRs must be used to track shipment of dioxin samples submitted for CLP analysis. See Guideline FT-7.04 for detailed description of the use of DSRs.~~

~~5.1.15 Hazardous Materials Shipping Document~~

~~A hazardous material shipping document should be completed each time supplies, samples or waste materials classified as hazardous materials by DOT (49CFR 171 through 177) are shipped. This form also provides certification to the carrier that the samples are identified, packaged, and presented for shipment in accordance with U.S. Department of Transportation regulations.~~

~~Attachment B-20 is an example of a Hazardous Material Shipping Document. Determination of which shipments fall under DOT regulations and how to fill out this document and DOT labels is described in Guideline FT-7.06. Hazardous materials shipping documents may be obtained from ZPMO or REM III Regional Offices.~~

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5.1.16 EPA Region III CLP Form

In addition to other forms described previously, EPA Region III requires the completion of a CLP Form as shown in Attachment B-21. Instructions for filling out the form are in FT-7.04, Attachment O.

5.2 GEOHYDROLOGICAL AND GEOTECHNICAL FORMS

5.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 should be filled out for each round of water level measurements at a site. These sheets are not controlled documents and can be obtained from ZPMO or REM III Regional Offices. Guidelines on usage of these forms are contained in FT-6.07. Alternative forms may be used, but must be shown and described in the FSAP.

5.2.2 Data Sheet for Aquifer Tests (Pumping Well)

During the performance of a pumping test, a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance. This form is not a controlled document and can be obtained from ZPMO or REM III Regional Offices. Guidelines for use of this form are contained in FT-6.05. Alternative forms may be used but must be shown and described in the FSAP.

5.2.3 Data Sheet for Aquifer Tests (Observation Well) or In Situ Hydraulic Conductivity Test

This data sheet (Attachment C-3) is similar to that described in Section 5.2.2. However, somewhat different data must be recorded for pumping test observation wells and in situ hydraulic conductivity tests, as shown on this sheet. This form is not a controlled document and may be obtained from ZPMO or REM III Regional Offices. Guidelines for use of this form are contained in FT-6.05 (pumping test) or FT-6.06 (in-situ hydraulic conductivity test). Alternative forms may be used but must be shown and described in the FSAP.

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5.2.4 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring (Attachment C-4) is used for this purpose. In addition, if volatile organics are monitored on cores, samples or cuttings from the borehole (using HNU or OVA detectors), the results are entered on the boring log at the appropriate depth. The boring log also provides space for entry of the laboratory sample number and the concentrations of a few key analytical results. This feature allows direct comparison of contaminant concentrations with soil characteristics. Alternative forms may be used but must be shown and described in the FSAP.

The Summary Log of Boring is not a controlled document. Blank sheets are available from ZPMO or REM III Regional Offices. Guidelines on completing boring logs are contained in FT-6.02.

5.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details form must be completed for every monitoring well installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter sand and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variations, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachment C-5 through C-7).

The Monitoring Well Construction Details form is not a controlled document. Blank sheets are available from ZPMO or REM III Regional Offices. Guidelines on completing this form are contained in FT-7.01. Alternative forms may be used but must be shown and described in the FSAP.

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5.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician. Test Pit Logs (Attachment C-8) are not controlled documents and are available from ZPMO or REM III Regional Offices. Use of these logs is described in Guideline FT-6.04. Alternative forms may be used but must be shown and described in the FSAP.

5.3 EQUIPMENT CALIBRATION AND MAINTENANCE FORMS

5.3.1 Equipment Calibration Log

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log (Attachment D-1) which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. This form is not a controlled document. It is assigned to a piece of equipment by the REM III Equipment Manager and accompanies that equipment at all times.

5.3.2 Equipment Calibration Tags

When equipment is calibrated, either by the manufacturer or by the user, an equipment calibration tag (Attachment D-2) must be affixed to the equipment and dated. These tags are not controlled documents; blank tags are available from the REM III Equipment Manager.

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5.3.3 Equipment Maintenance Log

An Equipment Maintenance Log (Attachment D-3) is assigned to each piece of equipment. It must be filled out whenever routine maintenance or repair is carried out. The Equipment Maintenance Logs are not controlled documents. Blank Equipment Maintenance Logs can be obtained from the REM III Equipment Manager. The Equipment Maintenance Log accompanies the equipment at all times; and up-to-date copy is filed by the REM III Equipment Manager.

5.3.4 Water Level Indicator Calibration Sheet

All devices used to measure groundwater levels must be periodically calibrated against a steel surveyors chain. This is required because in some cases, the depth readings on water level indicators may differ from the true depth to water. Attachment D-4 illustrates a water level indicator calibration sheet. These forms are not controlled documents and may be obtained from ZPMO or REM III Regional Offices. Guidelines for use of this form are provided in FT-6.07.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

Attachment A - Technical Forms in Current Use for Remedial Investigations in the REM III Program (2 Sheets)

Attachment B-1 - Sample Label

Attachment B-2 - Sample Identification Tag

Attachment B-3 - Chain-of-Custody Record Form, Region I

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EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROTECTION AGENCY
REM III PROGRAM GUIDELINES

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- Attachment B-4 - Chain-of-Custody Record Form, Region II
- Attachment B-5 - Chain-of-Custody Record Form, Region III
- Attachment B-6 - Chain-of-Custody Record Form, Region IV
- Attachment B-7 - Chain-of-Custody Seal
- Attachment B-8 - Receipt for Samples Form
- Attachment B-9 - Analytical Services Request Form
- Attachment B-10 - Bottle Delivery Order Form (CLP)
- Attachment B-11 - Repository Packing List Form
- Attachment B-12 - Sample Log Sheet
- Attachment B-13 - Table of Contents for Sample Log Notebook
- Attachment B-14 - Organics Traffic Report
- Attachment B-15 - Inorganics Traffic Report
- Attachment B-16 - High-Hazard Traffic Report
- Attachment B-17 - Traffic Report Labels
- Attachment B-18 - Special Analytical Services (SAS) Packing List
- Attachment B-19 - Dioxin Shipment Record
- Attachment B-20 - Example of a Hazardous Material Shipping Document
- Attachment B-21 - EPA Region III CLP Form
- Attachment C-1 - Groundwater Level Measurement Sheet
- Attachment C-2 - Data Sheet for Aquifer Tests (Pumping Well)
- Attachment C-3 - Data Sheet for Aquifer Tests (Observation Well) or In-Situ Hydraulic Conductivity Test

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- Attachment C-4 - Summary Log of Boring
- Attachment C-5 - Monitoring Well Construction Details (Well in Overburden)
- Attachment C-6 - Monitoring Well Construction Details (Well in Bedrock)
- Attachment C-7 - Monitoring Well Construction Details (Open Hole in Bedrock)
- Attachment C-8 - Test Pit Log
- Attachment D-1 - Equipment Calibration Log
- Attachment D-2 - Equipment Calibration Tags
- Attachment D-3 - Equipment Maintenance Log
- Attachment D-4 - Groundwater Level Indicator Calibration Sheet

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Technical Forms in Current Use for Remedial Investigations in
the REM III Program*

<u>Attachment No.</u>		<u>Form Usage Described in FT No.</u>	<u>Controlled/ Required Document</u>
B-1	Sample Label	7.05	required
B-2	Sample Identification Tag	7.05	controlled
B-3 - B-6	Chain-of-Custody Record	7.05	controlled
B-7	Chain-of-Custody Seal	7.05	controlled
B-8	Receipt for Sample Form	7.05	controlled
B-9	Analytical Services Request Form	7.04	required
B-10	Bottle Delivery Order Form (CLP)	7.04	required
B-11	Repository Packing List Form	7.04	required
B-12	Sample Log Sheet	7.04	no
B-13	Sample Log Notebook-Table of Contents	7.04	no
B-14	Organics Traffic Report	7.04	controlled (CLP)**
B-15	Inorganics Traffic Report	7.04	controlled (CLP)
B-16	High Hazard Traffic Report	7.04	controlled (CLP)
B-17	Traffic Report Lables	7.04	controlled (CLP)
B-18	Special Analytical Services (SAS) Packing List	7.04	required (CLP)
B-19	Dioxin Shipment Record	7.04	required (CLP)
B-20	Hazardous Material Shipping Document	7.06	required if hazard
B-21	EPA Region III CLP Form	7.04	required (CLP)
C-1	Groundwater Level Measurement Sheet	6.07	no
C-2	Data Sheet for Aquifer Tests (Pumping Well)	6.05	no
C-3	Data Sheet for Aquifer Tests (Observation Well) or In- Situ Hydraulic Conductivity Test	6.05/ 6.06	no
C-4	Summary Log of Boring	6.02	no

- * Examples of each form are attached to this FTG in the order listed on this Table.
- ** These forms required for CLP analyses. Equivalent forms required for non-CLP analyses.

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Technical Forms in Current Use for Remedial Investigations in
the REM III Program* (Con't.)

<u>Attachment No.</u>		<u>Form Usage Described in FT No.</u>	<u>Controlled/ Required Document</u>
C-5	Monitoring Well Construction Details (Overburden)	7.01	no
C-6	Monitoring Well Construction Details (Well in Bedrock)	7.01	no
C-7	Monitoring Well Construction Details (Openhole in Bedrock)	7.01	no
C-8	Test Pit Log	6.04	no
D-1	Equipment Calibration Log	***	no
D-2	Equipment Calibration Tags	***	no
D-3	Record of Equipment Maintenance	***	no
D-4	Groundwater Level Indicator Calibration Sheet	6.07	no

* Examples of each form are attached to this FTG in the
order listed on this Table.
*** See Section 5.3.1 of this guideline.

EBASCO	PROJECT: _____
SAMPLE NO. _____	
DATE: ____/____/____ TIME: _____ HRS	
MEDIUM: _____	
TYPE: GRAB <input type="checkbox"/> COMPOSITE <input type="checkbox"/>	
PRESERVATION: _____	
ANALYSIS: _____	
SAMPLED BY: _____	
LAB NO.: _____	
REMARKS: _____	

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 ☆ GPO 505-562

Project Code	Station No.	Month/Day/Year	Time	Designate		Station Location	Sampler (Signature)	Preservative: Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Comp	Grab			ANALYSES	
								BOD	Anions
								Solids	(TSS) (TDS) (SS)
								COD, TOC, Nutrients	
								Phenolics	
								Mercury	
								Metals	
								Cyanide	
								Oil and Grease	
								Organics GC/MS	
								Priority Pollutants	
								Volatile Organics	
								Pesticides	
								Mutagenicity	
								Bacteriology	
								Remarks:	
								Tag No.	
								Lab Sample No.	
								3 60966	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



300601

[illegible]

300601 A

GROUNDWATER LEVEL INDICATOR CALIBRATION SHEET

Project Name _____

Project No. _____

Equipment No. _____

Equipment Name _____

Date _____

Last Calibration _____

Calibration Period _____

Water Level
Indicator Marking
(Feet)

Actual Reading*
(Feet)

0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0

*NOTE: Record readings to the nearest 0.01 foot. The actual reading may be different than marking because the water level measuring device (electrode, popper, etc.) may extend beyond the "0" feet mark on the measuring line.

300602

300602 A

Instrument (Name/Model No./Serial No.)

Manufacturer**Date Purchased**[illegible]

ATTACHMENT 2-1
FT-13.C2, REV. 1

300602a

EQUIPMENT CALIBRATION TAGS

EBASCO	Equipment ID No. _____
Calibrated _____	Calibrated _____
Due _____	Due _____
Calibrated _____	Calibrated _____
Due _____	Due _____

EBASCO
CALIBRATION NOT REQUIRED

EBASCO
INACTIVE
CALIBRATE/REPAIR BEFORE USE

300603

U

Date Purchased

9

300604

300664

BORING NO. _____
**BEDROCK
MONITORING WELL SHEET**
OPEN HOLE WELL

PROJECT _____ PROJECT NO. _____ ELEVATION _____ FIELD GEOLOGIST _____	LOCATION _____ BORING _____ DATE _____	DRILLER _____ DRILLING _____ METHOD _____ DEVELOPMENT _____ METHOD _____
--	--	--

ELEVATION OF TOP OF CASING _____

STICK UP OF CASING ABOVE GROUND SURFACE _____

GROUND ELEVATION _____

TYPE OF SURFACE SEAL: _____

ID OF CASING: _____

TYPE OF CASING: _____

TEMP / PERM: _____

DEPTH TO BOTTOM CASING: _____

DIAMETER OF HOLE: _____

TYPE OF CASING SEAL: _____

DEPTH TO TOP OF ROCK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DESCRIBE IF CORE / REAMED WITH BIT: _____

DESCRIBE JOINTS IN BEDROCK AND DEPTH: _____

ELEVATION / DEPTH OF HOLE _____

STET

300606

SEE NUS
FORM

300606

BORING NO. _____

BEDROCK MONITORING WELL SHEET WELL INSTALLED IN BEDROCK

PROJECT _____ PROJECT NO. _____ ELEVATION _____ FIELD GEOLOGIST _____	LOCATION _____ BORING _____ DATE _____	DRILLER _____ DRILLING _____ METHOD _____ DEVELOPMENT _____ METHOD _____
--	--	--

ELEVATION OF TOP OF SURFACE CASING _____

STICK UP OF CASING ABOVE GROUND SURFACE _____

ELEVATION TOP OF RISER _____

TYPE OF SURFACE SEAL: _____

ID OF SURFACE CASING _____

DIAMETER OF HOLE: _____

RISER PIPE ID _____

TYPE OF RISER PIPE: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____

ELEVATION / DEPTH TOP OF BEDROCK: _____

TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF SAND: _____

ELEVATION / DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE & LENGTH: _____

ID SCREEN: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK _____

CORE / REAM _____

ELEVATION / DEPTH BOTTOM SCREEN _____

ELEVATION / DEPTH BOTTOM OF HOLE _____

300607

SEE NUS
FORM 114

BORING NO. _____

OVERBURDEN MONITORING WELL SHEET

PROJECT _____ PROJECT NO. _____ ELEVATION _____ FIELD GEOLOGIST _____	LOCATION _____ BORING _____ DATE _____	DRILLER _____ DRILLING METHOD _____ DEVELOPMENT METHOD _____
--	--	--

GROUND
ELEVATION

ELEVATION OF TOP OF SURFACE CASING _____

ELEVATION OF TOP OF RISER PIPE _____

STICK-UP TOP OF SURFACE CASING _____

STICK-UP RISER PIPE _____

TYPE OF SURFACE SEAL _____

I.D. OF SURFACE CASING _____

TYPE OF SURFACE CASING _____

RISER PIPE I.D. _____

TYPE OF RISER PIPE _____

BOREHOLE DIAMETER _____

TYPE OF BACKFILL _____

ELEVATION / DEPTH TOP OF SEAL _____

TYPE OF SEAL _____

DEPTH TOP OF SAND PACK _____

ELEVATION / DEPTH TOP OF SCREEN _____

TYPE OF SCREEN _____

SLOT SIZE & LENGTH _____

I.D. OF SCREEN _____

TYPE OF SAND PACK _____

ELEVATION / DEPTH BOTTOM OF SCREEN _____

ELEVATION / DEPTH BOTTOM OF SAND PACK _____

TYPE OF BACKFILL BELOW OBSERVATION WELL _____

ELEVATION / DEPTH OF HOLE _____

300608

SEE NUS FORM

300609 00-0000

DATA SHEET FOR AQUIFER TESTS (OBSERVATION WELL) OR
IN-SITU HYDRAULIC CONDUCTIVITY TEST

Project:
Type of Test:
Location:

Measured by:

Water level measurement
reference point:

Test No.:

<u>Date</u>	<u>Time</u>	<u>Depth to water (Ft)</u>	<u>Drawdown or Head (Ft)</u>	<u>Correction</u>	<u>Corrected Drawdown or Head (Ft)</u>	<u>Elapsed Time (Min)</u>	<u>Remarks</u>
-------------	-------------	------------------------------------	--------------------------------------	-------------------	--	-----------------------------------	----------------

SEE NUS
FORM

DATA SHEET FOR AQUIFER TESTS

Project:
Type of Test:
Location:

Discharge measured by:
Drawdown measured by:
Water level measurement
reference point:

Test No.:

<u>Date</u>	<u>Time</u>	<u>Depth to</u> <u>water</u> <u>(Ft)</u>	<u>Drawdown</u> <u>s (Ft)</u>	<u>Elapsed</u> <u>Time</u> <u>(Min)</u>	<u>Manometer</u> <u>Reading</u> <u>(In)</u>	<u>Dis-</u> <u>charge</u> <u>(Gal/Min)</u>	<u>Remarks</u>
-------------	-------------	--	----------------------------------	---	---	--	----------------

SEE NUS
FORM

300611

GROUNDWATER LEVEL MEASUREMENT SHEET

PROJECT NAME	_____	LOCATION	MUNICIPALITY	_____
PROJECT NO.	_____		COUNTY	_____
PERSONNEL	_____		STATE	_____
DATE	_____		STREET OR	_____
			MAP LOCATION	_____
			(IF OFF-SITE)	_____

WEATHER CONDITIONS			
TEMPERATURE RANGE	_____	EQUIPMENT NO.	_____
PRECIPITATION	_____	EQUIPMENT NAME	_____
BAROMETRIC PRESSURE	_____	LATEST CALIBRATION DATE	_____
TIDALLY-INFLUENCED	<input type="checkbox"/> YES		<input type="checkbox"/> NO

WELL OR PIEZOMETER NO.	DATE/ TIME	ELEVATION OF REFERENCE POINT (FEET)*	WATER LEVEL INDICATOR READING (FEET)*	ADJUSTED DEPTH (FEET)*	GROUNDWATER ELEVATION (FEET)*
------------------------------	---------------	--	--	------------------------------	-------------------------------------

* All elevations to nearest 0.01 feet.

300612

SAS REQUEST: (details required)

EPA Project Officer:

NOTICE

ATTACHMENT B-2:
FT-13.C2, REV. 1

NO	DATE	CLASS	IN	001 PARTS SURVIVAL	002-003 CRISIS	004	CONFIDENTIAL	PTC	DATE
1	01 Jul	200 lbs	0	001 PARTS SURVIVAL	002-003 CRISIS	004	CONFIDENTIAL	✓	1
2	01 Jul	200 lbs	0	001 PARTS SURVIVAL	002-003 CRISIS	004	CONFIDENTIAL	✓	1
3	01 Jul	200 lbs	0	001 PARTS SURVIVAL	002-003 CRISIS	004	CONFIDENTIAL	✓	1
4	01 Jul	200 lbs	0	001 PARTS SURVIVAL	002-003 CRISIS	004	CONFIDENTIAL	✓	1

SURVIVAL CERTIFICATION
This is to certify that the above named patients are properly described, described, prepared, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Signature: _____
Date: 01 Jul

Signature: _____
Date: 01 Jul

Signature: _____
Date: 01 Jul

Signature: _____
Date: 01 Jul

300514

USDA Contract Laboratory Program
Savannah Management Office
P O Box 818 Alexander Avenue 22313
OTS 8 357 2490 703 357 2490

CASE NO:

BATCH NO:

CLP DIOXIN SHIPMENT RECORD

Site Name	Sampling Date	Site No.	FOR LAB USE ONLY
City & State	City & State		Case Sampled Rec'd
EPA Site No.	Sampling Context	Date Shipped	Received By
Latitude	Sampling Date	Collector No.	Case Sampled Rec'd
Longitude	Case Temperature	Date Shipped	Received By
Year 1 2 3 4 5 6 7	15-Day _____ 30-Day _____		

[illegible]

WHITE - 40% +, YELLOW 30% +, BROWN 10% +, RED 10% +, BLUE 10% +, GREEN 10% +

300615

5-14000

U.S. ENVIRONMENTAL PROTECTION AGENCY
CLP Sample Management Office
P.O. Box 818 - Alexandria, Virginia 22313
Phone: 703/557-2690 - FTS/557-2690

SAS Number

**SPECIAL ANALYTICAL SERVICE
PACKING LIST**

Sampling Office:	Sampling Date(s):	Ship To:	For Lab Use Only
Sampling Contact:	Date Shipped:		Date Samples Rec'd:
(name)	Site Name/Code:	Attn:	Received By:
(phone)			

Sample Numbers	Sample Description i.e., Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

For Lab Use Only

White - SMO Copy, Yellow - Region Copy, Pink - Lab Copy for return to SMO, Gold - Lab Copy

300516

TRAFFIC REPORT LABELS

MAB 342

6003

AC 865 • Soil/Sediment
(VOA)

300617 810008

	DEPARTMENT OF DEFENSE, ENVIRONMENTAL PROTECTION AGENCY, DEFENSE CIVIL CONTROL ADMINISTRATION HIGH HAZARD TRAFFIC REPORT	Sample Number C 6003
---	---	--------------------------------

FIELD SAMPLE RECORD

① Case Number: Sample Site Name/Code: _____ _____ _____ _____	② Field Sample Description: — Drum — Aqueous Liquid — Sludge — Solid — Oil — Other _____	③ Ship To: Attn: _____
④ Sampling Office: _____ Sampling Personnel: _____ (name) _____ (phone) Sampling Date: _____ (begin) (end)	⑤ Known or Suspected Hazards: _____ _____ _____ _____ _____	⑥ Sample Location: _____ _____ _____
⑧ Shipping Information: _____ (name of carrier) _____ (date shipped) _____ (airbill number)	⑦ Preparations Requested: (check below) Sample Volume: _____ — Organics — Volatile Organics — Base Neutral Acid — TCDD — Pesticides, PCB — Inorganics — Total Metals — Total Mercury — Strong Acid Anions C 6003 C 6003 C 6003 C 6003 C 6003
⑨ Special Handling Instructions: <div style="text-align: right;">SMO Copy</div>		

300618

ATTACHMENT B-15
FT-13.02, REV.

INORGANIC TRAFFIC REPORT

FOR CLUB USE ONLY

TYPE OF ACTIVITY (CIRCLE ONE) ①
 SUPERFUND—PA SI ESI RIFS RD RA ER
 NPLO O&M OTHER _____
 NON-SUPERFUND— _____ PROGRAM

SITE NAME.

CITY, STATE.

SITE SPILL ID:

REGION NO: SAMPLING COMPANY ②

SAMPLER (NAME)

SHIP TO:

ATTN:

SAMPLING DATE:

BEGIN: _____ END: _____

DATE SHIPPED: _____ CARRIER: _____ ⑤

AIRBILL NO:

SAMPLE DESCRIPTION

(ENTER IN BOX A)

1 SURFACE WATER

2. GROUND WATER

3. LEACHATE

4 SOIL

5. SEDIMENT

6 OIL (SAS)

7. WASTE (SAS)

DOUBLE VOLUME REQUIRED FOR MATRIX SPIKE/DUPLICATE AQUEOUS SAMPLE

SHIP MEDIUM AND HIGH CONCENTRATION
SAMPLES IN PAINT CANS

SEE REVERSE FOR ADDITIONAL INSTRUCTIONS

[illegible]

USEPA CONTRACT LABORATORY PROGRAM
SAMPLE MANAGEMENT OFFICE
P.O. BOX 111, FALLS ANDORVA, VA 22031
(703) 557-2100 (703) 557-2490

CASE NO. _____ SAS NO. _____
(IF APPLICABLE)

ATTACHMENT B-1
FT-13.02, REV.

ORGANIC TRAFFIC REPORT

(FOR CLE USE ONLY)

TYPE OF ACTIVITY (CIRCLE ONE) ① SUPERFUND—PA SI ESI RIFS RD RA ER NPLD O&M OTHER _____ NON-SUPERFUND—_____ PROGRAM		SHIP TO. ②		SAMPLE DESCRIPTION (ENTER IN BOX A) 4. SOIL 1. SURFACE WATER 5. SEDIMENT 2. GROUND WATER 6. OIL (SAS) 3. LEACHATE 7. WASTE (SAS)	
SITE NAME _____		ATTN: _____		TRIPLE VOLUME REQUIRED FOR MATRIX SPIKE/DUPLICATE AQUEOUS SAMPLE	
CITY, STATE _____ SITE SPILL ID: _____		SAMPLING DATE: _____ ④		SHIP MEDIUM AND HIGH CONCENTRATION SAMPLES IN PAINT CANS	
REGION NO. _____ SAMPLING COMPANY ② _____		BEGIN: _____ END: _____		SEE REVERSE FOR ADDITIONAL INSTRUCTIONS	
SAMPLER (NAME) _____		DATE SHIPPED: _____ CARRIER: _____ ⑤			
		AIRBILL NO: _____			

CLP SAMPLE NUMBER (FROM LABELS)	SAMPLE DESCRIPTION ② (FROM BOX 1) 1 2 3 4 5 6 7	CONCENTRATION ③ 1 = LOWEST N = HIGHEST (ppm)	RAS ANALYSIS ⑥				SPECIAL HANDLING ⑦	STATION LOCATION ⑧	
			VOLATILE	BASE/NEUT	ACID	PESTICIDE			
									CM 001 - Water (Extractable)
									CM 001 - Water (Extractable)
									CM 001 - Water (Extractable)
									CM 001 - Water (Extractable)
									CM 001 - Water (VOA)
									CM 001 - Water (VOA)
									CM 001 - Soil/Sediment (Extractable)
									CM 001 - Soil/Sediment (Extractable)
									CM 001 - Soil/Sediment (VOA)
									CM 001 - Soil/Sediment (VOA)

300520

TABLE OF CONTENTS

[illegible]

SAMPLE LOG SHEET

ATTACHMENT E-11
FT-13.02, REV. 1

I. SAMPLE IDENTIFICATION

PROJECT SITE NAME: _____ EPA PROJECT SITE NO. _____
 REM III CONTRACTOR: _____ SITE MANAGER: _____
 SAMPLE NAME/NUMBER: _____ DATE ____/____/____ TIME: _____ HRS
 SAMPLING LOCATION/DEPTH _____ TYPE: ____ GRAB ____ COMPOSITE
 SAMPLE MATRIX: ____ SURFACE WATER ____ GROUNDWATER ____ SEDIMENT ____ SOIL
 ____ WASTE ____ OTHER (SPECIFY) _____
 ☐ ENVIRONMENTAL SAMPLE ☐ HAZARDOUS SAMPLE
 SAMPLED BY: (PRINT) _____ (SIGNATURE) _____

II. SAMPLE SOURCE

____ WELL ____ OUTFALL ____ LEACHATE ____ DRUM
 ____ BORING ____ RIVER/STREAM ____ BLDG/STRUCTURE ____ OTHER
 ____ TEST PIT/TRENCH ____ IMPOUNDMENT ____ TANK (SPECIFY) _____

SOURCE DESCRIPTION _____

III. FIELD OBSERVATIONS/MEASUREMENTS

APPEARANCE/COLOR: _____
 VOLATILE ORGANIC ANALYSIS (VOA): ____ ENU ____ OVA ____ OTHER
 VOA READINGS: OFF SAMPLE _____ RESPIRATORY ZONE _____
 LEL/O₂/H₂S READINGS: _____
 RADIOACTIVITY (MR/HR): _____
 PH: _____ CONDUCTIVITY: _____ TEMPERATURE: _____
 SALINITY: _____ OTHER: _____
 OBSERVATIONS: _____

IV. SAMPLE DISPOSITION

PRESERVATION: _____
 LABORATORY NAME: _____
 LABORATORY LOCATION: ____ ON-SITE ____ OFF-SITE
 FORWARDED TO LABORATORY: DATE ____/____/____ TIME: _____ HRS
 LABORATORY SAMPLE NO. _____ TR/SAS/ _____
 CHAIN-OF-CUSTODY NO. _____ DSR NOS. _____

V. ADDITIONAL REMARKS

300622

CUSTODY SEAL			CUSTODY SEAL
_____ Date			_____ Date
_____ Signature			_____ Signature

300623

300623

~~U S ENVIRONMENTAL PROTECTION AGENCY~~
~~REGION 4~~

300624

[illegible]

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[illegible]

3-15966

300625

CHAIN OF CUSTODY RECORD

ENVIRONMENTAL PROTECTION AGENCY - REGION 6
SURVEILLANCE & ANALYSIS DIVISION
BOSTON, NEW JERSEY 08027

Name of Site and Address						
Sample Number	Number of Containers	Description of Sample				
Person Assuming Responsibility for Sample					Time	Date
Sample Number	Subsampled By	Received By	Time	Date	Reason for Change of Custody	
Sample Number	Subsampled By	Received By	Time	Date	Reason for Change of Custody	
Sample Number	Subsampled By	Received By	Time	Date	Reason for Change of Custody	
Sample Number	Subsampled By	Received By	Time	Date	Reason for Change of Custody	

300526



EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROTECTION AGENCY
REM III PROGRAM GUIDELINES

		Page 3 of 5
CATEGORY:	TITLE:	No. FT-13.03
Field	Site Logbook	DATE:
Technical		10/30/87

REVISION 1

3.0 DEFINITIONS

Site Logbook - The logbook is a bound notebook with consecutively numbered pages that cannot be removed. Upon entry of data, the logbook requires signature by the responsible site leader (see Section 5.1).

4.0 RESPONSIBILITIES

The site logbook is issued by the Regional Manager (or his designee) to the Site Manager for the duration of the project. The Site Manager releases the site logbook to the Field Operations Leader or other person responsible for the direction of on-site activities (e.g., Reconnaissance Survey Team Leader, Sampling Team Leader). It is the responsibility of this person (or his designee) to keep the site logbook current while in his possession, and return it to the Site Manager or turn it over to another field team. Following the completion of all fieldwork, the site logbook is returned to the Site Manager for inclusion in the permanent site files.

5.0 GUIDELINES

5.1 GENERAL

The cover of each site logbook contains the following information:

- . Project Name and EPA Work Assignment Number
- . Ebasco Project Number (4236.XXX)
- . RI/FS Contractor and Site Manager's Name
- . Sequential Book Number
- . Start Date
- . End Date

300627

450008



EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROTECTION AGENCY
REM III PROGRAM GUIDELINES

		Page 4 of 5
CATEGORY:	TITLE:	No. FT-13.03
Field	Site Logbook	DATE:
Technical		10/30/87

REVISION 1

Daily entries into the logbook may contain a variety of information. At the beginning of each day the following information must be recorded:

- . Date
- . Start time
- . Weather
- . All field personnel present
- . Any visitors present

During the day, a summary of all site activities and level of personal protection should be recorded in the logbook. The information need not duplicate that recorded in other field notebooks (e.g., sample logbook, Site Geologist's notebook, Health and Safety Officer's notebook, etc.), but should summarize the contents of these other notebooks and refer to the page locations in these notebooks for detailed information. An example of a site logbook page is shown in Attachment A.

The sample logsheet for each sample collected (see Guideline FT-7.04) must be referenced. If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the notebook and page number(s) on which they are recorded (see Attachment A).

All entries should be made in black pen. No erasures are permitted. If an incorrect entry is made, the data should be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook must be signed. It must also be signed by the Field Operations Leader or responsible site leader at the end of each day.

5.2 PHOTOGRAPHS

The record of photographs taken at a site for the purpose of project documentation must be recorded in the site logbook or a field notebook (see guideline FT-7.05). When movies, slides, or photographs are taken of a site or any monitoring location, they are numbered to correspond to logbook entries. The name of the photographer, date, time, site location, site description, and

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		Page 5 of 5
CATEGORY:	TITLE:	No. FT-13.03
Field	Site Logbook	DATE:
Technical		10/30/87

REVISION 1

weather conditions are entered in the logbook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook. If possible, such techniques should be avoided, since they can adversely affect the admissibility of photographs as evidence. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigations require chain-of-custody procedures. Adequate logbook notations and receipts may be used to account for routine film processing. Once processed, the slides of photographic prints shall be serially numbered and labeled according to the logbook descriptions.

6.0 REFERENCES

Program Guideline FT-7.05 - Sample Identification and Chain-Of-Custody

Program Guideline FT-7.04 - Management of Sampling and Preparation of Required Forms.

7.0 ATTACHMENTS

Attachment A - Typical Site Logbook Entry

300629

TYPICAL SITE LOGBOOK ENTRY

START TIME: 08:00

DATE: 9/14/85

SITE LEADER: _____

PERSONNEL: EBASCO

DRILLER

EPA

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenny and fire hoses were set up.
2. Drilling activities at well _____ resumed. Rig geologist was _____. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4" stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____. See Geologist's Notebook, No. 2, page _____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for one hour. At the end of the hour, water pumped from well was "sand-free".
6. EPA remedial project manager arrives on-site at 14:25 hrs.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit _____ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hrs. Site activities terminated at 18:22 hours. All personnel offsite, gate locked.

300630

Field Operations Leader

**ENVIRONMENTAL PROTECTION AGENCY
REM III PROGRAM GUIDELINES**

Page 7 of 12

CATEGORY:	TITLE:	No. HS-1.08
Health and	Air Monitoring and Sampling	DATE:
Safety		01/10/86

REVISION 0

Another specialty adsorbent selected for the specific site. For example, a Florisil tube could be used if polychlorinated biphenyls are expected.

5.3.2 Inorganic Gases

The inorganic gases present at an incident would primarily be polar compounds such as the haloacid gases. They can be adsorbed onto silica gel tubes and analyzed by ion chromatography. Impingers filled with selected liquid reagents can also be used.

5.3.3 Aerosols

Aerosols (solid or liquid particulates) that may be encountered at an incident include contaminated and noncontaminated soil particles, heavy-metal particulates, pesticide dusts, and droplets of organic or inorganic liquids. An effective method for sampling these materials is to collect them on a particulate filter such as a glass fiber or membrane type. A backup impinger filled with a selected absorbing solution may also be necessary.

5.3.4 Other Methods

Colorimetric detector tubes can also be used with a sampling pump when monitoring for some specific compounds. Passive organic vapor monitors can be substituted for the active system described if passive monitors are available for the types of materials suspected to be present at a given site.

5.3.5 Information Resource

The National Institute for Occupational Safety and Health's (NIOSH) Manual of Analytical Methods, Volumes 1-7, contains acceptable methods for collecting and analyzing air samples for a variety of chemical substances. Consult it for specific procedures.

300631

07/08/86

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AR300632

FORMULA: CH_3Br

METHYL BROMIDE

M.W.: 94.94

METHOD: 2520

ISSUED: 5/15/85

OSHA: 20 ppm

NIOSH: Group I Pesticide [1]

ACGIH: 5 ppm (skin)

(1 ppm = 3.88 mg/m³ @ NTP)

PROPERTIES: gas; BP 3.6 °C; MP -94 °C;

vapor density (air = 1) 3.3;

explosive range 13.5 to 14.5% v/v in air

SYNONYMS: bromomethane; CAS #74-83-9.

SAMPLING	MEASUREMENT
SAMPLER: SOLID SORBENT TUBES (two petroleum charcoal tubes, 400 mg and 200 mg)	! TECHNIQUE: GAS CHROMATOGRAPHY, FID ! ! ANALYTE: methyl bromide ! ! DESORPTION: 2 mL CS_2 ; stand 60 min ! ! INJECTION VOLUME: 5 μL ! ! TEMPERATURE-INJECTION: 155 °C ! -DETECTOR: 200 °C ! -COLUMN: 65 °C ! ! CARRIER GAS: N_2 , 30 mL/min ! ! COLUMN: 6 m x 3 mm stainless steel packed with ! 10% FFAP on 100/120 mesh Chromosorb WHP ! ! CALIBRATION: methyl bromide in CS_2 ; internal ! standard ! ! RANGE: 0.2 to 2 mg per sample ! ! ESTIMATED LOD: 0.01 mg per sample [2] ! ! PRECISION (s_r): 0.053 @ 0.4 to 1.6 mg per ! sample [2] !
FLOW RATE: 0.01 to 1 L/min	
VOL-MIN: 2.5 L @ 20 ppm -MAX: 11 L	
SHIPMENT: routine	
SAMPLE STABILITY: >7 days @ 20 °C	
FIELD BLANKS: 10% (≥ 2) of samples	
ACCURACY	
RANGE STUDIED: 35 to 150 mg/m ³ [2] (11-L samples)	
BIAS: not significant @ 71 to 160 mg/m ³ ; -13% at 30 mg/m ³ [2]	
OVERALL PRECISION (s_r): 0.103 [2]	
APPLICABILITY: The working range is 40 to 400 mg/m ³ (10 to 100 ppm) for a 5-L air sample. NIOSH has sampled for methyl bromide at grain elevators [3,4].	
INTERFERENCES: None known. A 2 m x 3 mm ID glass column packed with 1% SP-1000 also has been used [3].	
OTHER METHODS: This revises Method S372 [5].	

5/15/85

2520-1

300633

REAGENTS:

1. Eluent: carbon disulfide,* chromatographic quality, containing 0.1% v/v n-decane, n-pentane or other suitable internal standard.
2. Methyl bromide, 99.5%.*
3. Calibration stock solution, ca. 200 mg/mL. Bubble methyl bromide gas slowly into eluent into a fritted glass bubbler. Determine the methyl bromide concentration by comparison with gas standards.
4. Nitrogen, purified.
5. Hydrogen, prepurified.
6. Air, filtered.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: two glass tubes connected in series with a short piece of plastic tubing; each tube 10 cm long, 8 mm OD, 6 mm ID, containing 20/40 mesh activated (600 °C) petroleum charcoal (front = 400 mg; back = 200 mg). A plug of silylated glass wool is placed at each end of each tube. Pressure drop across sampler <3.4 kPa (2.5 cm Hg) at 1 L/min airflow. Four plastic caps are used to seal the tubes after sampling. *SKC pump*
2. ~~Personal sampling pump~~, 0.01 to 1 L/min, with flexible connecting tubing.
3. Gas chromatograph, FID, integrator and column (page 2520-1).
4. Vials, 5-mL, glass, with PTFE-lined caps.
5. Syringe, gas-tight, 10-mL.
6. Microliter syringes, 10-μL.
7. Pipets, 2-mL, graduated in 0.1-mL increments.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and an extreme fire and explosion hazard (flash point = -30 °C).

Methyl bromide has poor warning properties and can produce fatal pulmonary edema at high concentrations; chronic exposure can cause CNS depression and kidney injury [6,7]. Contact between methyl bromide and aluminum or strong oxidizers may cause fire or explosion.

SAMPLING:*

1. Calibrate each *SKC pump* ~~personal sampling pump~~ with a representative sampler in line.
2. Break the ends of the sampler tubes immediately before sampling. Attach sampler to *SKC* ~~personal sampling pump~~ with flexible tubing. *150-200 cc/min*
3. Sample at an accurately known flow rate between 0.01 and 1 L/min for a total sample size of *2.5 to 11 L approximately 7 hrs* ~~0.01 and 1 L/min for a total sample size of 2.5 to 11 L~~.
4. Separate the front and back tubes immediately after sampling. Cap the tubes. Pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections in separate vials. Discard the glass wool and foam plugs.
6. Add 2.0 mL eluent to each vial. Immediately cap each vial.
7. Allow to stand 60 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least five working standards over the range 0.01 to 2 mg methyl bromide per sample.
 - a. Add known amounts of calibration stock solution, or a serial dilution thereof, to known volumes of eluent in vials. Immediately cap each vial.
 - b. Analyze together with samples and blanks (steps 11 and 12).
 - c. Prepare calibration graph (ratio of peak area of analyte to peak area of internal standard vs. mg methyl bromide).

300634

5/15/85

2520-2

* Prior to sampling, draeger tubes shall be used to estimate gross
contaminant levels. The air sampler shall run for 7-8 hours unless
draeger tubes results indicate that absorbent capacity would be exhausted

9. Determine desorption efficiency (DE) at least once for each lot of charcoal used for sampling in the calibration range (step 8). Prepare three tubes at each of five levels plus three media blanks.
 - a. Inject a known amount (1 to 10 μ L) of calibration stock solution, or a serial dilution thereof, directly onto front sorbent section of a media blank sampler with a microliter syringe.
 - b. Cap the tube. Allow to stand overnight.
 - c. Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12).
 - d. Prepare a graph of DE vs. mg methyl bromide recovered.
10. Analyze three quality control blind spikes and three analyst spikes to ensure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 2520-1. Inject sample aliquot manually using solvent flush technique or with autosampler.

NOTE: If peak area is above the linear range of the working standards, dilute an aliquot of the desorbed liquid with eluent, reanalyze, and apply the appropriate dilution factor in calculations.
12. Measure peak area. Divide the peak area of analyte by the peak area of internal standard on the same chromatogram.

CALCULATIONS:

13. Determine the mass, mg (corrected for DE) of methyl bromide found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blanks for the front (B_f) and back (B_b) sorbent sections.

NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
14. Calculate concentration, C, of methyl bromide in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Method 5372 was issued on June 6, 1975 [5], and validated at 35, 75, and 150 mg/m^3 [2]. Test atmospheres were generated by delivering methyl bromide gas from a cylinder via an orifice and needle valve to a dry airstream flowing at a rate of 0.1 m^3/min . The concentration was confirmed with a total hydrocarbon analyzer calibrated with known amounts of methyl bromide gas. Six samples at each level were collected (11-L sample volume) on SKC Lot 104 petroleum-based charcoal and stored seven days prior to analysis. Recoveries were 87, 96, and 107% at 30, 75, and 150 mg/m^3 , respectively, for 11-L air samples. The average recovery was 96.5% with a $s_p = 10.3\%$. Desorption efficiency was 0.72, 0.81, and 0.82 at 0.4, 0.8, and 1.6 mg methyl bromide per sample, respectively.

A test determined that 10 to 20% of the methyl bromide collected on the front section migrated to the back section after storage for seven days prior to analysis. For this reason, separate tubes for the front and back sections are specified.

Breakthrough (5%) occurred after sampling 18 L of an atmosphere containing 161 mg/m^3 methyl bromide at 0.19 L/min; the front sorbent section held 2.9 mg methyl bromide.

REFERENCES:

- [1] Criteria for a Recommended Standard...Occupational Exposure During the Manufacture and Formulation of Pesticides, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-174 (1978), available as PB 81-227001 from NTIS, Springfield, VA 22161.
- [2] Documentation of the NIOSH Validation Tests, S372, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977), available as PB 274-248 from NTIS, Springfield, VA 22161.
- [3] UBTI, Inc., NIOSH Sequence #3709-H (NIOSH, unpublished, November 19, 1982).
- [4] Arthur D. Little, Inc., NIOSH Sequence #4264 (NIOSH, unpublished, February 29, 1984).
- [5] NIOSH Manual of Analytical Methods, 2nd ed., Vol. 3, S372, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).
- [6] NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, U.S. Department of Health and Human Services, Publ. (NIOSH) 81-123 (1981), available as GPO Stock #017-033-0037-8 from Superintendent of Documents, Washington, DC 20402.
- [7] The Merck Index, 9th ed., Merck & Co., Inc., Rahway, NJ (1976).

METHOD REVISED BY: Y. T. Gagnon, NIOSH/DPSE.

FORMULA: (1) Aniline: C_6H_7N
(2) *p*-Toluidine: C_7H_9N
(3) 2,4-Xylidine: $C_8H_{11}N$
(4) *N,N*-Dimethyl-*p*-toluidine: $C_9H_{13}N$
(5) *N,N*-Dimethylaniline: $C_8H_{11}N$

METHOD: 2002
ISSUED: 5/15/85

OSHA/NIOSH/ACGIH: Table 1

PROPERTIES: Table 1

SYNONYMS: (1): benzenamine; aminobenzene; CAS #62-53-3. (2): 2-aminotoluene; CAS# 95-53-4.
(3): 2,4-dimethylaniline; CAS #95-68-1. (4): p-dimethylaminotoluene;
(5): N,N-dimethylbenzeneamine; CAS #121-69-7. CAS #99-97-8.

5/15/85

2002-1

300637

REAGENTS:

1. Ethanol, 95%, non-denatured, chromatographic quality.
2. n-Hexane.
3. Benzene.*
4. Analytes, reagent grade.*
5. Aniline calibration stock solution, 102.2 mg/mL.* Dissolve 1 mL aniline in 2 mL benzene; dilute to 10 mL with hexane.
NOTE: Benzene possibly could be replaced with toluene, alcohol, or acetone to minimize the analyst's exposure to suspect carcinogens. Effects of this substitution are not known and should be tested.
6. p-Toluidine calibration stock solution, 100.6 mg/mL.* Dilute 1 mL p-toluidine to 10 mL with n-hexane.
7. 2,4-Xylidine calibration stock solution, 97.8 mg/mL.* Dilute 1 mL 2,4-xylidine to 10 mL with n-hexane.
8. N,N-Dimethyl-p-toluidine calibration stock solution, 93.5 mg/mL.* Dilute 1 mL N,N-dimethyl-p-toluidine to 10 mL with n-hexane.
9. N,N-Dimethylaniline calibration stock solution, 95.6 mg/mL.* Dilute 1 mL N,N-dimethylaniline to 10 mL with hexane.
10. Hydrogen, prepurified.
11. Helium, Bureau of Mines Grade A.
12. Nitrogen, purified.
13. Air, filtered, compressed.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6 mm OD, 4 mm ID; with plastic caps; containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam (front = 150 mg; back = 75 mg). For N,N-dimethyl-p-toluidine, a front section of 100 mg and back section of 50 mg may be used. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available.
2. ~~Personal sampling pump, 0.02 to 1 L/min, with SKC pump~~ flexible connecting tubing.
3. Gas chromatograph, FID, integrator and column (page 2002-1).
4. Vials, glass, 2-mL; PTFE-lined crimp caps.
5. Syringes, 10-, 25-, 50- and 100- μ L.
6. Pipets, 1- and 2-mL.
7. Ultrasonic bath.
8. File.
9. Tweezers.
10. Flasks, volumetric, 10-mL.

SPECIAL PRECAUTIONS: n-Hexane and ethanol are flammable. Aniline, p-toluidine, 2,4-xylidine, and benzene are suspect carcinogens [7,8]. Absorption through skin is a potential hazard. All work with these chemicals should be performed in a hood. Use proper protective clothing including gloves. Analytes (1), (2), (3), and (5) are severe poisons.

SAMPLING:

SKC

1. Calibrate each ~~personal~~ sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to ~~personal~~ SKC sampling pump with flexible tubing. (150-200 c/min) for approximately 7 hrs.
3. Sample at an accurately known flow rate/~~for a total sample size according to Table 2.~~
4. Cap the samplers. Pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Add the glass wool plug to the front sorbent section vial. Discard the foam plugs.
6. Add 1.0 mL 95% ethanol to each vial. Attach crimp cap to each vial.
7. Allow to stand 1 hr in an ultrasonic bath.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least five working standards over the range 0.01 to 3 mg analyte per sample.
 - a. Add known amounts of calibration stock solution, or a dilution thereof, in n-hexane to 95% ethanol in 10-mL volumetric flasks and dilute to the mark.
 - b. Analyze together with samples and blanks (steps 11 and 12).
 - c. Prepare calibration graph (peak area or height vs. mg analyte).
9. Determine desorption efficiency (DE) at least once for each lot of silica gel used for sampling in the calibration range. Prepare three tubes at each of five levels plus three media blanks.
 - a. Remove and discard back sorbent section of a media blank sampler.
 - b. Inject a known amount (1 to 20 μ L) of calibration stock solution, or a dilution thereof, in hexane directly onto front sorbent section with a microliter syringe.
 - c. Cap the tube. Allow to stand overnight.
 - d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12).
 - e. Prepare a graph of DE vs. mg analyte recovered.
10. Analyze three quality control blind spikes and three analyst spikes to ensure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 2002-1. Inject sample aliquot manually using solvent flush technique or with autosampler. Use the following conditions as a guide (these were used in development of the methods [1]):

COMPOUND	TEMPERATURES, °C		
	Injection	Column	Detector
Aniline	230	165	245
p-Toluidine	240	180	265
2,4-Xylidine	230	170	235
N,N-Dimethyl-p-toluidine	250	180	250
N,N-Dimethylaniline	150	100 for 4 min, then 8°/min to 225	250

NOTE: If peak response is above the linear range of the working standards, dilute with 95% ethanol, reanalyze, and apply the appropriate dilution factor in calculations.

12. Measure peak area or height.

300639

5/15/85

2002-3

* Prior to sampling with fix sampler, draeger tubes shall be used to estimate gross contaminant levels. The air sampler shall run for 7 hours unless draeger tubes results indicate that absorbant capacity would be exhausted.

CALCULATIONS:

13. Determine the mass, mg (corrected for DE) of analyte found in the sample front (M_f) and back (M_b) sorbent sections, and in the average media blank front (B_f) and back (B_b) sorbent sections.

NOTE: If $M_b > M_f/10$, report breakthrough and possible sample loss.

14. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(M_f + M_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Precisions, biases and recoveries listed below were determined by analyzing generated atmospheres containing one-half, one and two times the OSHA standard [1]. Generated concentrations were independently verified. Breakthrough of the front section of the silica gel tube was not observed after sampling a dry test atmosphere. The first three analytes were stable on silica gel for at least one week. Method S164 using collection on activated charcoal was also developed for N,N-dimethylaniline [3].

Substance	Sampling		Range, mg/m ³ (volume)	Overall Precision (s _r)	Measurement		Desorption efficiency
	Breakthrough volume in dry air at concentration				Range (mg)	Precision (s _r)	
	(L)	(mg/m ³)					
Aniline	>44.4	38	9.5-38.2 (20 L)	0.060	0.20-0.82	0.013	0.980-1.00
p-Toluidine	>221.3	47	11.7-46.9 (50 L)	0.060	0.55-2.2	0.032	0.970-0.983
2,4-Xylidine	>44.4	50	12.5-50.0 (20 L)	0.057	0.25-1.01	0.021	0.959-1.015
N,N-Dimethyl- p-toluidine	*	*	9.4-30.0 (100 L)	*	0.47	0.035	0.88
N,N-Dimethyl- aniline	*	*	*	0.090	0.05-3.0	*	0.997 (1.9-mg samples)

*Not determined.

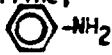
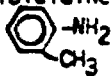
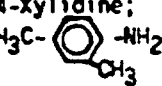

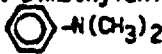
REFERENCES:

- [1] Documentation of the NIOSH Validation Tests, S162, S164, S168, S310, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977), available as GPO Stock #017-033-00231-2 from Superintendent of Documents, Washington, DC 20402.
- [2] UBTI, Inc., Sequence #2300-S, Aniline (May 15, 1980), and Sequence #2551-M, p-Toluidine (August 28, 1980) (NIOSH, unpublished).
- [3] NIOSH Manual of Analytical Methods, 2nd ed., Vol. 3, S162, S164, S168, S310, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).

- [4] Ibid., Vol. 4, P&CAM 280, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-175 (1978).
- [5] Ibid., Vol. 1, P&CAM 168, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1977).
- [6] Campbell, E. E., G. O. Wood and R. G. Anderson. Los Alamos Scientific Laboratory Progress Reports LA-5104-PR, LA-5164-PR, LA-5308-PR, LA-5389-PR, LA-5484-PR and LA-5634-PR, Los Alamos, NM (November, 1972; January, 1973; June, 1973; August, 1973; December, 1973; and June, 1974).
- [7] Registry of Toxic Effects of Chemical Substances, 1979 eds., Vols. 1 and 2, U.S. Department of Health and Human Services, Publ. (NIOSH) 80-111 (1980).
- [8] NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, Aniline and o-Toluidine, U.S. Department of Health and Human Services, Publ. (NIOSH) 81-123 (1981), available as GPO Stock #017-033-00337-8 from Superintendent of Documents, Washington, DC 20402.

METHOD REVISED BY: Paula M. Fey O'Connor, Julie R. Okenfuss and George Williamson, NIOSH/DPSE.

Table 1. Physical properties and personal exposure limits.

Substance; Structural Formula	BP (°C)	MP (°C)	d, g/mL @ 20 °C	VP @ 25 °C kPa (mm Hg)	Personal exposure limits (ppm) OSHA ACGIH	Conversion factor (ppm to mg/m ³ @ NTP)
Aniline; 	184	-6	1.022	0.089 (0.67)	5 (skin) 2 (skin)	3.81
p-Toluidine; 	200	-15	1.006	0.043 (0.32)	5 (skin) 2 (skin)*	4.38
2,4-Xylidine; 	214	-14	0.9723	<0.1 (<1)	5 (skin) 2 (skin)	4.95
N,N-Dimethyl-p-toluidine; 	211	NA	0.935	NA	--	5.53
N,N-Dimethylaniline; 	192	2	0.956	<0.1 (<1)	5 (skin) 5 (skin); STEL 10	4.95

*Suspect carcinogen.

NA = not available.

Table 2. Sampling flow rates and volumes.

Substance	Flow Rate (L/min)	SAMPLING Volume (L)		Working Range (mg/m ³)
		MIN	MAX	
Aniline	0.02 - 0.2	5	30	5 - 60 (20-L samples)
p-Toluidine	0.02 - 1.0	10	150	5 - 60 (55-L samples)
2,4-Xylidine	0.02 - 0.2	3	30	3 - 75 (20-L samples)
N,N-Dimethyl-p-toluidine	0.02 - 1.0	*	*	9 - 30 (100-L samples)
N,N-Dimethylaniline	0.02 - 1.0	3	30	1.3 - 79 (38-L samples)

*Not determined.

United States
Environmental Protection
Agency

Office of Pesticides
and Toxic Substances
Washington, DC 20460

EPA 560 5 85 028
June 1985

Toxic Substances



Guidance for Controlling Asbestos-Containing Materials in Buildings



300643

Appendix G. Specifications for Sampling Materials and Selecting a Qualified Laboratory to Analyze for Asbestos

G.1 Collecting Samples

Taking a sample of ACM can damage the material and cause significant release of fibers. The following guidelines are designed to minimize both damage and fiber release.¹

- Wear at least a half-face respirator with disposable filters (see Section 5.1).
- Wet the surface of the material to be sampled with water from a spray bottle or place a plastic bag around the sampler.
- Sample with a reusable sampler such as a cork borer or a single-use sampler such as a glass vial. (Figure G-1 shows a single-use sampler constructed from an acrylic tube.)
- With a twisting motion, slowly push the sampler into the material. Be sure to penetrate any paint or protective coating and all the layers of the material.
- For reusable samplers, extract and eject the sample into a container. Wet-wipe the tube and plunger. For single-use samplers, extract, wet-wipe the exterior, and cap it.
- Label the container.
- Clean debris using wet towels and discard them in a plastic bag.
- For surfacing material, use latex paint or a sealant to cover the sample area. For pipe and boiler insulation, use a nonasbestos mastic.

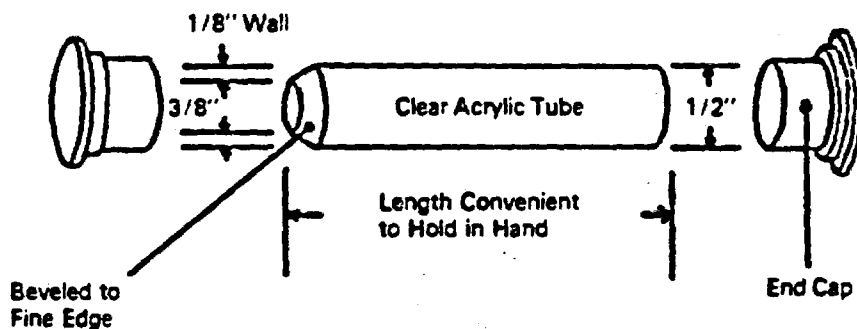


Figure G-1 - Sampler/container

300644

G.2 Selecting a Qualified Laboratory

The U.S. Environmental Protection Agency (EPA) runs a bulk asbestos sample quality assurance program. Updated lists of participating laboratories, their performance scores, and further information on the program are available from the Asbestos Technical Information Service at (800) 334-8571 (Extension 6741).

¹ The guidelines are based on information in John T. Jankovic, "Asbestos Bulk Sampling Procedure," American Industrial Hygiene Association, 46, B-8 to B-10, 1985.

B

300645

APPENDIX B
LIST OF FORMS

300646

NUS CORPORATION
DAILY RECORD
SUBSURFACE INVESTIGATION

Site Name: _____ Project No.: _____
EPA Region: _____ Location: _____
Date: _____ Arrival Time: _____ Departure Time: _____
Contractor: _____ Driller: _____
Boring No.: _____ Drill Rig: _____

Item (1)	Original Quantity (2) Estimate	Quantity Today (2)	Previous Total (2) Quantity	Cummulative Quantity (2) To Date
----------	--------------------------------------	-----------------------	-----------------------------------	--

300647

Comments:

- (1) As Listed in Specs
(2) Include Quantity and Units

Approved by:

NUS Field Representative

Driller or Representative

BORING LOG

NUS CORPORATION.

PROJECT
PROJECT NO..
ELEVATION.
WATER LEVEL DATA
(Date, Time & Coord : cns)

DATE _____
FIELD GEOLOGIST _____

**BORING NO
DRILLER:**

[illegible]REMARKS _____

BORING _____

* See Legend on Back

PAGE ____ OF ____

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TEST PIT LOG

TEST PIT LOG

PROJECT: TEST PIT NO.:
PROJECT NO.: DATE:
LOCATION:
FIELD GEOLOGIST:

[illegible]

Test Pit Cross Section and / or Plan View

[illegible]

PHOTO LOG TEST PIT

300649 PAGE 1 OF 1

300649



N A Halliburton Company

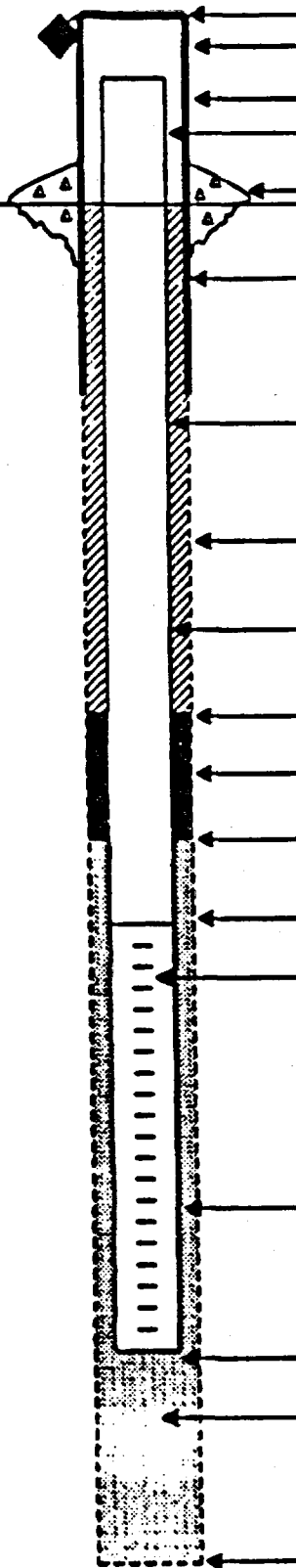
BORING NO. _____

OVERBURDEN MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING _____
METHOD _____
DEVELOPMENT _____
METHOD _____

GROUND
ELEVATION



ELEVATION OF TOP OF SURFACE CASING: _____
ELEVATION OF TOP OF RISER PIPE: _____

STICK - UP TOP OF SURFACE CASING: _____
STICK - UP RISER PIPE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

RISER PIPE I D _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____

TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION / DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. OF SCREEN: _____

TYPE OF SAND PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____

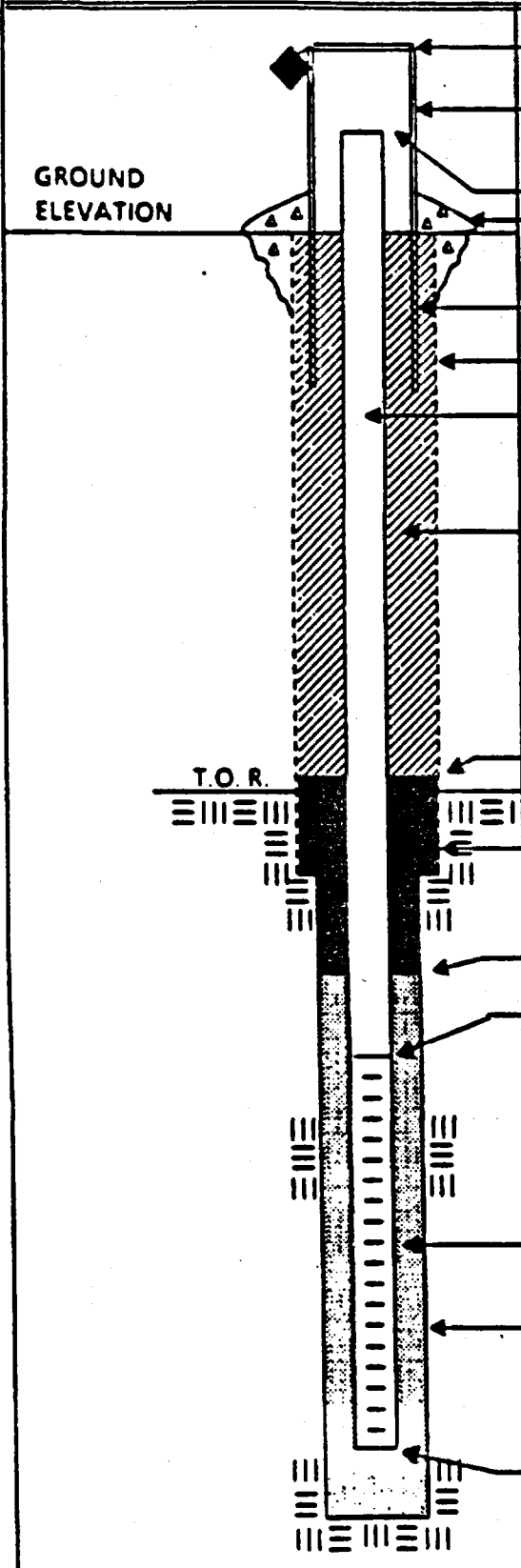
ELEVATION / DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION
WELL: _____

300650
ELEVATION / DEPTH OF HOLE: _____

BEDROCK MONITORING WELL SHEET WELL INSTALLED IN BEDROCK

BORING NO. _____

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING _____
ELEVATION _____	DATE _____	METHOD _____
FIELD GEOLOGIST _____		DEVELOPMENT _____
		METHOD _____



ELEVATION OF TOP OF SURFACE CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____

DIAMETER OF HOLE: _____

RISER PIPE I.D.: _____

TYPE OF RISER PIPE: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____

ELEVATION / DEPTH TOP OF BEDROCK: _____

TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF SAND: _____

ELEVATION / DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. SCREEN: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

CORE / REAM: _____

ELEVATION / DEPTH BOTTOM SCREEN: _____

ELEVATION / DEPTH BOTTOM OF HOLE: _____



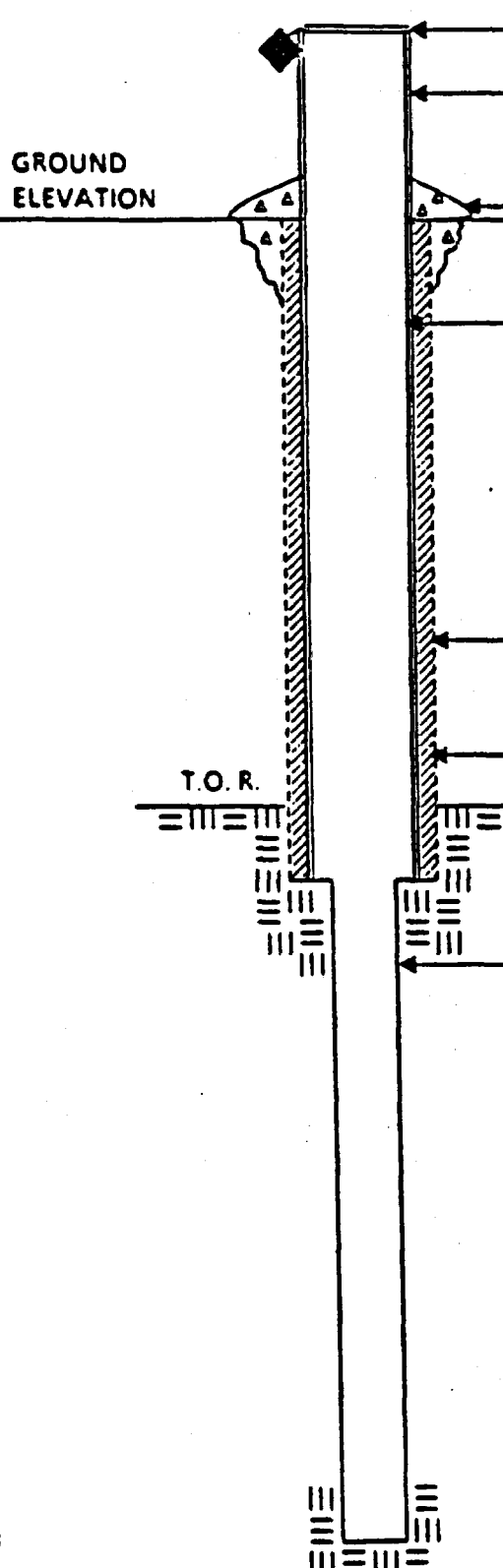
N A Halliburton Company

BEDROCK
MONITORING WELL SHEET
OPEN HOLE WELL

BORING NO. _____

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING
METHOD _____
DEVELOPMENT
METHOD _____

	ELEVATION OF TOP OF CASING: _____
	STICK UP OF CASING ABOVE GROUND SURFACE: _____
	TYPE OF SURFACE SEAL: _____
	I.D. OF CASING: _____
	TYPE OF CASING: _____
	TEMP. / PERM.: _____
	DEPTH TO BOTTOM CASING: _____
	DIAMETER OF HOLE: _____
	TYPE OF CASING SEAL: _____
	DEPTH TO TOP OF ROCK: _____
DIAMETER OF HOLE IN BEDROCK: _____	
DESCRIBE IF CORE / REAMED WITH BIT: _____ _____ _____	
DESCRIBE JOINTS IN BEDROCK AND DEPTH: _____ _____ _____	
ELEVATION / DEPTH OF HOLE: _____	

300652



COMPUTED _____ CHECKED _____
PROJECT NO. _____
PAGE _____ OF _____

[illegible]

LOCATION MUNICIPALITY _____
COUNTY _____
STATE _____
STREET OR _____
MAP LOCATION _____
(IF OFF-SITE) _____

EQUIPMENT NO. _____
EQUIPMENT NAME _____
LATEST CALIBRATION DATE _____

TIDALLY-INFLUENCED ☐ YES

[illegible]

300654

IN-SITU HYDRAULIC CONDUCTIVITY TEST

Name of Observer_____

Drawdown measured by _____

Water level measurement
reference point

Barometric Pressure _____

Static water level
before test

Water sample collected
before test

after test

Duration _____

[illegible]

SAMPLE LOG SHEET

ATTACHMENT B
FT-7.02, REV. 1

I. SAMPLE IDENTIFICATION

PROJECT SITE NAME: _____ EPA PROJECT SITE NO. _____
 REM III CONTRACTOR: _____ SITE MANAGER: _____
 SAMPLE NAME/NUMBER: _____ DATE ____/____/____ TIME: _____ HRS
 SAMPLING LOCATION/DEPTH _____ TYPE: ____ GRAB ____ COMPOSITE
 SAMPLE MATRIX: ____ SURFACE WATER ____ GROUNDWATER ____ SEDIMENT ____ SOIL
 ____ WASTE ____ OTHER (SPECIFY) _____
 ☐ ENVIRONMENTAL SAMPLE ☐ HAZARDOUS SAMPLE
 SAMPLED BY: (PRINT) _____ (SIGNATURE) _____

II. SAMPLE SOURCE

____ WELL ____ OUTFALL ____ LEACHATE ____ DRUM
 ____ BORING ____ RIVER/STREAM ____ BLDG/STRUCTURE ____ OTHER
 ____ TEST PIT/TRENCH ____ IMPOUNDMENT ____ TANK (SPECIFY) _____

SOURCE DESCRIPTION _____

III. FIELD OBSERVATIONS/MEASUREMENTS

APPEARANCE/COLOR: _____
 VOLATILE ORGANIC ANALYSIS (VOA): ____ HNU ____ OVA ____ OTHER
 VOA READINGS: OFF SAMPLE _____ RESPIRATORY ZONE _____
 LEL/O₂/H₂S READINGS: _____
 RADIOACTIVITY (MR/HR): _____
 PH: _____ CONDUCTIVITY: _____ TEMPERATURE: _____
 SALINITY: _____ OTHER: _____
 OBSERVATIONS: _____

IV. SAMPLE DISPOSITION

PRESERVATION: _____
 LABORATORY NAME: _____
 LABORATORY LOCATION: ____ ON-SITE ____ OFF-SITE
 FORWARDED TO LABORATORY: DATE ____/____/____ TIME: _____ HRS
 LABORATORY SAMPLE NO. _____ TR/SAS/ _____
 CHAIN-OF-CUSTODY NO. _____ DSR NOS. _____

V. ADDITIONAL REMARKS

300656

EBASCO	PROJECT: _____
SAMPLE NO. _____	
DATE: ____/____/____	TIME: _____ HRS
MEDIUM: _____	
TYPE: GRAB <input type="checkbox"/> COMPOSITE <input type="checkbox"/>	
PRESERVATION: _____	
ANALYSIS: _____	
SAMPLED BY: _____	
LAB NO.: _____	
REMARKS: _____	

ATTACHMENT A

SAMPLE LABEL

300657

☆ GPO 505-552

Project Code	Station No	Month/Day/Year	Time	Designate		Samples (Signatures)	Preservative: Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Comp	Orab		ANALYSES	
Station Location						BOD		
						Anions		
						Solids (TSS) (TDS) (SS)		
						COD, TOC, Nutrients		
						Phenolics		
						Mercury		
						Metals		
						Cyanide		
						Oil and Grease		
						Organics GC/MS		
						Priority Pollutants		
						Volatile Organics		
						Pesticides		
						Mutagenicity		
						Bacteriology		
Remarks:								
Tag No.				Lab Sample No.				
3 60966								

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



ATTACHMENT B

SAMPLE IDENTIFICATION TAG

300658

CHAIN OF CUSTODY RECORD

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

[illegible]

Distribution Original Assignments Statement Copy to Correspondents Field \$400

3-15966

CHAIN-OF-CUSTODY RECORD FORM FOR USE IN REGION III
(Original is 8-1/2 x 11 3/4")

300659

CUSTODY SEAL			CUSTODY SEAL
_____ Date			_____ Date
_____ Signature			_____ Signature

ATTACHMENT D
CHAIN-OF-CUSTODY SEAL

300660

WEEKLY FIELD SUMMARY REPORT

SUNDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

MONDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

TUESDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

WEDNESDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

THURSDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

FRIDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

SATURDAY

Date : _____ Personnel _____
Weather: _____ Onsite _____

Site Activities: _____

SAMPLE LOG SHEET

I. SAMPLE IDENTIFICATION

PROJECT SITE NAME: _____ EPA PROJECT SITE NO. _____
REM III CONTRACTOR: _____ SITE MANAGER: _____
SAMPLE NAME/NUMBER: _____ DATE ____/____/____ TIME: _____ HRS
SAMPLING LOCATION/DEPTH _____ TYPE: _____ GRAB _____ COMPOSITE
SAMPLE MATRIX: _____ SURFACE WATER _____ GROUNDWATER _____ SEDIMENT _____ SOIL
_____ WASTE _____ OTHER (SPECIFY) _____
☐ ENVIRONMENTAL SAMPLE ☐ HAZARDOUS SAMPLE
SAMPLED BY: (PRINT) _____ (SIGNATURE) _____

II. SAMPLE SOURCE

_____ WELL _____ OUTFALL _____ LEACHATE _____ DRUM
_____ BORING _____ RIVER/STREAM _____ BLDG/STRUCTURE _____ OTHER
_____ TEST PIT/TRENCH _____ IMPOUNDMENT _____ TANK _____ (SPECIFY) _____

SOURCE DESCRIPTION _____

_____III. FIELD OBSERVATIONS/MEASUREMENTS

APPEARANCE/COLOR: _____
VOLATILE ORGANIC ANALYSIS (VOA): _____ HNU _____ OVA _____ OTHER
VOA READINGS: OFF SAMPLE _____ RESPIRATORY ZONE _____
LEL/O₂/H₂S READINGS: _____
RADIOACTIVITY (MR/hr): _____
PH: _____ CONDUCTIVITY: _____ TEMPERATURE: _____
SALINITY: _____ OTHER: _____
OBSERVATIONS: _____

IV. SAMPLE DISPOSITION

PRESERVATION: _____
LABORATORY NAME: _____
LABORATORY LOCATION: _____ ON-SITE _____ OFF-SITE
FORWARDED TO LABORATORY: DATE ____/____/____ TIME: _____ HRS
LABORATORY SAMPLE NO. _____ TR/SAS/ _____
CHAIN-OF-CUSTODY NO. _____ DSR NOS. _____

300665

V. ADDITIONAL REMARKS

115 APP. C48.5

FOR CLP USE ONLY

YELLOW - 223

SAMPLE MANAGEMENT OFFICE
P.O. BOX 818 ALEXANDRIA
703/557-2490 FAX 557-2490

ATTACHMENT B-15
FT-13.02, REV. 1

INORGANIC TRAFFIC REPORT

FOR CLUB USE ONLY

TYPE OF ACTIVITY (CIRCLE ONE) ①
 SUPERFUND—PA SI ESI RIFS RD RA ER
 NPLD O&M OTHER _____
 NON-SUPERFUND—_____ PROGRAM

SITE NAME

CITY. STATE

SITE SPILL ID:

REGION NO

SAMPLING COMPANY ②

SAMPLER (NAME)

SHIP TO.

ATTN

SAMPLING DATE:

BEGIN _____ **END**

DATE SHIPPED: _____ CARRIER _____

AIRBILL NO

SAMPLE DESCRIPTION

(ENTER IN BOX A)

1 SURFACE WATER	4 SOIL
2 GROUND WATER	5 SEDIMENT
3 LEACHATE	6 OIL (SAS)
	7 WASTE (SAS)

DOUBLE VOLUME REQUIRED FOR MATRIX SPIKE/DUPLICATE AQUEOUS SAMPLE

SHIP MEDIUM AND HIGH CONCENTRATION
SAMPLES IN PAINT CANS

SEE REVERSE FOR ADDITIONAL INSTRUCTIONS

[illegible]

MCL 751 - Total Metals

MCL 751 - Total Metals

MCL 751 - Cyanide

MCL 751 - Cyanide

MCL 751

MCL 751

№ 751

300668

	<h2 style="margin: 0;">HIGH HAZARD TRAFFIC REPORT</h2>	Sample Number C 6003
---	--	--------------------------------

FIELD SAMPLE RECORD

① Case Number: _____ Sample Site Name/Code: _____ _____ _____ _____	② Field Sample Description: — Drum — Aqueous Liquid — Sludge — Solid — Oil — Other: _____	③ Ship To: _____ Attn: _____
④ Sampling Office: _____ Sampling Personnel: _____ (name) _____ (phone) Sampling Date: (begin) _____ (end) _____	⑤ Known or Suspected Hazards: _____ _____ _____ _____ _____	⑥ Sample Location: _____ _____ _____
⑧ Shipping Information: _____ (name of carrier) _____ (date shipped) _____ (airbill number) _____	⑦ Preparations Requested: (check below) Sample Volume: _____ — Organics — Volatile Organics — Base Neutral Acid — TCDD — Pesticides, PCB — Inorganics — Total Metals — Total Mercury — Strong Acid Anions C 6003 ----- C 6003 ----- C 6003 ----- C 6003 ----- C 6003
⑨ Special Handling Instructions: <div style="text-align: center; margin-top: 50px;">SMO Copy</div>		

300669

TRAFFIC REPORT LABELS

MAB 342

6003

AC 865 • Soil/Sediment
(VOA)

300670

U.S. ENVIRONMENTAL PROTECTION AGENCY
CLP Sample Management Office
P.O. Box 818 - Alexandria, Virginia 22313
Phone: 703/557-2490 - FTS/557-2490

SAS Number

SPECIAL ANALYTICAL SERVICE
PACKING LIST

Sampling Office: _____ Sampling Contact: _____ (name) _____ (phone)	Sampling Date(s): _____ Date Shipped: _____ Site Name/Code: _____	Ship To: _____ Attn: _____	For Lab Use Only Date Samples Rec'd: _____ Received By: _____
---	--	-------------------------------------	---

Sample Numbers	Sample Description i.e., Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____
15. _____	_____	_____
16. _____	_____	_____
17. _____	_____	_____
18. _____	_____	_____
19. _____	_____	_____
20. _____	_____	_____

For Lab Use Only

White - SMO Copy, Yellow - Region Copy, Pink - Lab Copy for return to SMO, Gold - Lab Copy

300671

USEPA Contract Laboratory Program
Sample Management Office
P.O. Box 818 Alexandria Virginia 22313
FNS 855 249C 7C3 557 249C

CASE NO.

BATCH NO:

CLP DIOXIN SHIPMENT RECORD

Site Name	Sampling Office	Site No.	FOR LAB USE ONLY
City & State	City & State		Date Samples Rec'd
EPA Site No.	Sampling Contact:	Date Shipped	Received By
Latitude	Name	Transfer To	Date Samples Rec'd
Longitude	Sampling Date	Date Shipped	Received By
Year 1 2 3 4 5 6 7	Date Turnaround		
Notes (2x4)	15 Day _____ 30 Day _____		

[illegible]

WHITE - 40% , YELLOW - 20% , BROWN - 10% , RED - 10% , BLUE - 10% , GOLD - 10%

300672

EQUIPMENT CALIBRATION LOG

Instrument (Name/Model No./Serial No.):

Manufacturer**Date Purchased**[illegible]

300674

EQUIPMENT CALIBRATION TAGS

<u>EBASCO</u>	Equipment ID No. _____
Calibrated _____	Calibrated _____
Due _____	Due _____
Calibrated _____	Calibrated _____
Due _____	Due _____

<u>EBASCO</u>
CALIBRATION NOT REQUIRED

<u>EBASCO</u>
INACTIVE
CALIBRATE/REPAIR BEFORE USE

300675

[illegible]

Manufacturer	Date Purchased

300676

GROUNDWATER LEVEL INDICATOR CALIBRATION SHEET

Project Name _____

Project No. _____

Equipment No. _____

Equipment Name _____

Date _____

Last Calibration _____

Calibration Period _____

Water Level
Indicator Marking
(Feet)

Actual Reading*
(Feet)

0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0

*NOTE: Record readings to the nearest 0.01 foot. The actual reading may be different than marking because the water level measuring device (electrode, popper, etc.) may extend beyond the "0" feet mark on the measuring line.

300677

C

300678

APPENDIX C
ASTM SAMPLING METHODS AND LYSIMETER INSTALLATION

300679



D 2901

~~At least~~ percent moisture of test sample as determined in Note 2, and V_w , M , and W , are quantities computed in Section 6 for calibration Set 2.

10. Precision and Accuracy

10.1 In the process of development of D 2901-70, interlaboratory testing programs were conducted in 1967 and 1968. Results of these tests showed an average error in cement

content determination of 3.6 % [(error)/(component content) \times 100] from which a coefficient of variation of 4.5 % is estimated. On duplicate specimens used in the calibration process, the average deviation in millilitres of EDTA was 2.4 % [(deviation in millilitres)/(average millilitres) \times 100].

10.2 Changes incorporated in the 1992 revision of D 2901-70, interlaboratory testing programs are intended to improve precision and accuracy over that of D 2901-70.

~~The American Society for Testing and Materials, whose no position regarding the validity of any patent rights asserted in connection with any item mentioned in this standard is expressed, and whose members are not to be held responsible for any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.~~

~~This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, then reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at the meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing, you should present your views to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103.~~



Designation: D 2922 - 81

Standard Test Methods for DENSITY OF SOIL AND SOIL-AGGREGATE IN PLACE BY NUCLEAR METHODS (SHALLOW DEPTH)¹

This standard is issued under the fixed designation D 2922; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or approval.

These methods have been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.

INTRODUCTION

These methods describe determination of the density of soil and soil-aggregate in place using nuclear equipment. In general, the total or wet density of the material under test is determined by placing a gamma source and a gamma detector either on, into, or adjacent to the material under test. These variations in test geometry are presented as the backscatter, direct transmission, or optional air gap approaches. The intensity of radiation detected is dependent in part upon the density of the material under test. The radiation intensity reading is converted to measured wet density by a suitable calibration curve. Principles of the nuclear test are discussed in the Appendix, as are some of its advantages and disadvantages. It should be noted that the density determined by these methods is not necessarily the average density within the volume involved in the measurement and that the equipment utilizes radioactive materials which may be hazardous to the health of users unless proper precautions are taken.

1. Scope

1.1 These methods cover the determination of the total or wet density of soil and soil-aggregate in place by the attenuation of gamma rays where the gamma source or gamma detector, or both, remain at or near the surface. The methods described are normally suitable to a test depth of approximately 2 to 12 in. (50 to 300 mm), depending on the test geometry used.

1.2 Three methods are described as follows:

Method	Section
Method A—Backscatter	9
Method B—Direct Transmission	10
Method C—Air Gap (Optional)	11

1.3 The values tested in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

2. Applicable Documents

2.1 *ASTM Standards:*

- D 1556 Test Method for Density of Soil in Place by the Sand-Cone Method²
- D 2167 Test Method for Density of Soil in Place by the Rubber-Balloon Method³
- D 2216 Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures⁴
- D 3017 Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)⁵

3. Significance and Use

3.1 The methods described are useful as rapid, nondestructive techniques for the in-place determination of wet density of soil and

¹ These methods are under the jurisdiction of ASTM Committee D 18 on Soil and Rock.

² Current edition approved May 29, 1981. Published September 1981. Originally published as D 2922-71. Last previous edition D 2922-70.

³ Annual Book of ASTM Standards, Vol 04.08.

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soil-aggregate. The fundamental assumptions inherent in the methods are that Compton scattering is the dominant interaction and that the material within the zone of influence for each test is homogeneous.

3.2 Test results may be affected by chemical composition, sample heterogeneity, and the surface texture of the material being tested. The techniques also exhibit spatial bias in that the apparatus is more sensitive to certain regions of the material under test.

4. Calibration

4.1 Laboratory calibration of the gage is established by determining the nuclear count rate of each of several materials at different and known densities and establishing a relationship between count rate and density. Sufficient data should be taken at each density to ensure a precision of at least twice the normal precision obtained in field use. Calibration can be accomplished by either laboratory or field methods. Laboratory methods are recommended due to the higher inherent accuracy of laboratory standards and instruments as opposed to field methods which require the volume measurement of an excavated hole.

NOTE 1—Different chemical compositions of the blocks or other materials can affect the count rate. Calibration curves may not be applicable to materials not represented in establishing the calibration curve.

4.1.1 Laboratory calibration should involve the use of a minimum of five homogeneous blocks sufficiently large to represent an infinite volume to the nuclear instrument. The density of these standards shall be determined to an accuracy of $\pm 0.2\%$ ($\pm 0.3 \text{ lb/ft}^3$ at 160 lb/ft^3 or $\pm 5 \text{ kg/m}^3$ at 2565 kg/m^3). Three of the standards shall be constructed of materials having gamma mass attenuation coefficients within $\pm 1.0\%$ of each other over the range of gamma energy utilized by the gage for density measurement. These standards will be used to establish the gage response to density variations in the range from 100 to 170 lb/ft^3 (1600 to 2725 kg/m^3). The last two standards shall be materials that equally bracket the gamma mass attenuation coefficient of soils. Suggested materials are limestone and granite. The gage response will then be related about the zero density point on a plot or graphical representation such that it falls halfway between the limestone and granite data. This final response

will be used in the field for measurement.

4.1.2 Field calibration may be used where laboratory calibration facilities are not available or where it becomes necessary to calibrate the instrument for materials that chemically are different than soils. A minimum of ten field tests should be used for establishing calibration by the field method so that a range of densities and materials will be represented. The sand-cone method in accordance with Test Method D 1556 or the rubber-hallon method in accordance with Test Method D 2167 may be used to determine the wide range of density of carefully selected field sites on which density data have been previously determined. As an alternative, nuclear data can be obtained on prepared containers of soil and soil aggregate compacted to known densities. The containers must be sufficiently large to represent an infinite volume to the nuclear instrument. Data from either of these methods may be used to establish a new gage response by visually fitting a line to a plot of gage response to density over the range of densities found in the samples. It is more desirable to use the latter data to rotate the laboratory calibration in 4.1.1, or a constant offset from the laboratory calibration to fit the field data. Extreme care must be exercised in the determination of wet density in either the field sites or prepared containers. Because of the variability and scatter inherent in field tests and container preparation and compaction, this method is considered less accurate than techniques using calibration blocks.

NOTE 2—Use of blocks is advantageous because they are durable and provide stable density references. Blocks and prepared containers are large enough not to change the observed count rate (for event ratios) if made larger than any dimensions (dimensions of approximately 10 in. (250 mm) width by 14 in. (340 mm) depth by 22 in. (560 mm) length have proven satisfactory for equipment now available. Calibration of backscatter with a depth of less than 9 in. (230 mm) is adequate.

4.2 Checking and Adjusting Calibration

Data for calibration data for newly acquired instruments, instruments for which the calibration is more than one year old, or instruments that have been damaged and repaired may be checked by using the method of 4.1.2. A minimum of ten field tests must be used to compare with the existing calibration data in order to justify changing the calibration.

4.3 Effect of the field test on the calibration

more than 3% from the nuclear density and some of the field densities are greater and some less than the nuclear density, then adjustment of the calibration is not necessary.

4.2.2 If all of the field tests are more or all less than the nuclear density and the average of the difference exceeds 1%, then adjust each subsequent nuclear density by the average difference.

4.2.3 The average difference found in 4.2.2 may be used to determine a new calibration constant offset from the original calibration may be used.

NOTE 3—Adjusting calibration curve is a complex task and it should be attempted only by those knowledgeable in this field. Most manufacturers either provide this service or will offer assistance to the user.

5. System Specifications

5.1 Any equipment that is used under the requirements of this method shall satisfy the following specifications:

5.1.1 Precision—Precision of the system is determined from the slope of the calibration response and the statistical deviation of the count for the recommended period of measurement, which shall be at least 1 min:

$$P = \sigma / S$$

where:

P = precision,
σ = standard deviation, counts per measurement period, and

S = slope, Δ counts per measurement period / (lb/ft³) or (kg/m³).

5.1.1.1 Determine the slope of the counts per measurement period at a unit weight of 125 lb/ft³ (2000 kg/m³). This can usually be determined from the calibration response and must be the true counts from the detector system before the display. Determine the counts per measurement period at the same density by the same method. The precision can be calculated by:

$$P = \sqrt{C/PC/S}$$

where:

P = precision,

C = counts per measurement period,

S = slope, Δ counts per measurement period / (lb/ft³) or (kg/m³), and

PC = amount of prescale (Note 4) applied to

the detector counts prior to display. The manufacturer will supply this value. If no prescale is built into the equipment, the value is 1.

NOTE 4—The value of prescale is the number by which the total count rate of the detector(s) is divided before display on the readout to eliminate the need for displaying non-significant digits. The value of P at a density of 125 lb/ft³ (2000 kg/m³) shall be no greater than $\pm 1.0 \text{ lb/ft}^3$ ($\pm 16 \text{ kg/m}^3$) for the backscatter methods not greater than $\pm 0.35 \text{ lb/ft}^3$ ($\pm 6 \text{ kg/m}^3$) for direct transmission method.

5.1.1.2 If 5.1.1 cannot be performed as above, the precision can be computed by determining the standard deviation of at least 20 repetitive measurements (gages not moved after the first measurement) of material having density of $125.0 \pm 5.0 \text{ lb/ft}^3$ ($2000 \pm 80 \text{ kg/m}^3$). In order to perform this procedure, the resolution of the count display, calibration response, or other method of displaying density must be equal to or better than $\pm 0.1 \text{ lb/ft}^3$ ($\pm 1.6 \text{ kg/m}^3$).

5.1.2 Chemical Error—The error due to changes in chemical composition of materials having gamma mass attenuation coefficients less than those of granite or greater than those of limestone shall be not greater than $\pm 2.5\%$ of backscatter methods and $\pm 1.2\%$ for direct transmission with the source at a depth of 6 in. (150 mm).

5.1.2.1 If the instrument was originally calibrated by the method described in 4.1.1, then the chemical error can be easily determined by using the standard block data which was taken to determine the gage response. Using the gage count rate on the limestone standard and the calibrated gage response, determine the gage density of the limestone standard. This will normally be higher than the true density. Compute the percent error. Repeat the same procedure for the granite standard. This will normally be lower than the true density. The difference between the two percent errors (taking into account the sign of the error) divided by two will equal the chemical error.

5.1.2.2 If the gage was calibrated by some means other than 4.1.1 or if the original calibration data are not available, then other means must be used to determine the chemical error. Using the procedure of 5.1.2.1, the relative densities of the limestone and granite standard blocks were not important, but using this procedure the standards should preferably be

300681

within 5 lb/ft³ (80 kg/m³) of each other in order to eliminate the possibility of an improper calibration which could cause good accuracy and small chemical error at the limestone and granite density but with large errors at all other densities. A high-density limestone or marble standard is suggested. First measure the density and compute the percent error on each standard. The chemical error is then the difference between the two errors divided by two. The sum of the two errors represents the calibration accuracy.

5.1.3 Surface Roughness Error.—The error caused by a 0.050-in. (1.3-mm) air gap introduced between the base of the gage and the surface of the material being measured should cause an error of no more than 4% in the backscatter method nor more than 1% in the direct-transmission method with the source placed at a 6-in. (150-mm) depth. Older models of instruments currently in use may not meet this requirement. The users can minimize the effects of surface roughness by careful site preparation.

5.1.3.1 The effect of surface roughness can be measured by placing the instrument on a smooth flat surface after cleaning both the surface and the gage base and measuring the density. Next, elevate the gage by placing 0.050-in. (1.3-mm) spacers between the gage base and the material surface in such a way as to not interfere with the gage measurement zone. Remasure the apparent density; the difference represents the gage error.

6. Safety Precaution

6.1 This equipment utilizes radioactive materials which may be hazardous to the health of the users, unless proper precautions are taken. Users of this equipment must become completely familiar with possible safety hazards and with all applicable government regulations. Effective operator instruction together with routine safety procedures such as source leak tests, recording and elevation of film badge data, use of survey meters, etc., are an essential part of the operation of equipment of this type.

7. Apparatus

7.1 The apparatus may consist of items to perform Method A—Backscatter, Method B—Direct Transmission, or a combination of both.

Items listed are common to both apparatus except where noted as Method A or Method B only. Apparatus for Method C—Air Gap (optional) is detailed in Section 11.

7.2 Gamma Source.—An encapsulated and sealed radioactive source meeting the specific form requirements of Title 49 of the Code of Federal Regulations.

7.3 Gamma Detector.—Any suitable type.

7.4 Readout Device.—A suitable scaler with a resolution and range to display counts over the range of density for which the apparatus will be used. Usually the scaler will also contain other electronic devices and the necessary electrical power for operation.

7.5 Housing.—The source, detector, readout device, etc., shall be in housings of rugged construction that are moisture- and dustproof. For Method B use, the housing shall contain a means of locating either the source or detector at a distance of 2 to 12 in. (50 to 300 mm) into a preformed hole in the material to be tested. The probe containing the source or detector shall be sufficiently rigid so as to maintain a constant distance along the measuring path length and also contain markings to indicate the depth to which the probe has been placed.

Notes 5.—The gamma source, detector, readout device, and power supply may be housed separately or combined and integrated with a nuclear measuring system.

7.6 Reference Standard.—A device that isolates the instrument and provides a means of allowing the instrument to make a measurement that is constant within the reproducibility of the system. All calibrations will be made as a ratio to the reference standard count and all field measurements will be taken as a ratio to the reference standard count.

7.7 Site Preparation Devices

7.7.1 Method A equipment shall include a flat plate straightedge, or other suitable tool to be used to level the test site to the required smoothness.

7.7.2 Method B equipment shall, in addition to the above, include a hole-forming device such as an auger or pin having a nominal diameter equal to or up to ¼ (3 mm) larger than the probe and also a guide to ensure that the hole is perpendicular to the test site surface.

7.8 Transport Case. Each system shall include a shipping and transport case to house

the equipment and shall meet the U.S. Department of Transportation requirements in Title 49 of the Code of Federal Regulations. The exterior of the case shall contain all labels required by the regulations and radiation levels shall meet the "Yellow II" standards.

8. Standardization

8.1 All nuclear density instruments are subject to long-term aging of the radioactive source, detectors, and electronic systems, which may change the relationship between count rate and density. To offset this aging, all instruments are calibrated as a ratio of the measurement count rate to a count rate made on a reference standard. The reference count rate should be in the same order of magnitude or higher than the range of measurement count rates over the useful density range of the equipment.

8.2 Standardization of equipment on the reference standard is required at the start of each day's use and a permanent record of these data should be retained.

8.3 Turn on the equipment and allow for stabilization of the equipment in accordance with the manufacturer's recommendations.

8.4 Take at least four repetitive readings at the normal measurement period and obtain the mean. If available on the instrument, one measurement at a period of four times the normal period is acceptable. This constitutes one standardization check.

8.5 If the value obtained above is within the limits set by Eq 3, the equipment is considered to be in satisfactory condition and may be used. If the value obtained is outside the limits set by Eq 3, another standardization check should be made. If the second standardization check is within the limits, the equipment may be used; but if it also fails the test, the equipment should be checked as recommended by the manufacturer and the calibration checked (4.2) or recalibrated, or both.

$$N_s = N_r \pm 2.0 \sqrt{N_r/PC}$$

where:

N_s = value of current standardization check (8.4) on the reference standard (7.6).

N_r = average of the past four values of N_s taken for prior usage, and

PC = amount of prescale applied to the detector counts prior to display. The manu-

facturer will supply this value. If no prescale is built into the equipment, the value is 1.

8.6 The value of N_s (8.4) will be used to determine the count ratios for the current day's use of the equipment. If, for any reason, measured densities become suspect during the day's use, another standardization should be performed.

NOTE 6.—If the instrument is to be used either continuously or intermittently during the day, it is generally best to leave it in the "power on" or "standby" condition during the day to prevent having to repeat the standardization. This will provide more stable, consistent results.

NOTE 7.—Standardization shall be performed in accordance with the manufacturer's recommendations and away from other radioactive sources, large masses of metal or vertical objects, free water, or other items that can affect the gage readings.

9. Procedure, Method A—Backscatter

9.1 Standardize the instrument (Section 8).

9.2 Select a test location where the gage in test position will be at least 9 in. (230 mm) away from any vertical projection.

9.3 Prepare the test site in the following manner:

9.3.1 Remove all loose and disturbed material and additional material as necessary to expose the top of the material to be tested.

NOTE 8.—The spatial bias should be considered in determining the depth at which the gage is to be seated.

9.3.2 Prepare a horizontal area sufficient in size to accommodate the gage, by planing the area to a smooth condition so as to obtain maximum contact between the gage and material being tested.

9.3.3 The maximum void beneath the gage shall not exceed approximately ¼ in. (3 mm). Use native fines or fine sand to fill these voids and smooth the surface with a rigid plate or other suitable tool.

NOTE 9.—The placement of the gage on the surface of the material to be tested is critical to the successful determination of density. The optimum condition is total contact between the bottom surface of the gage and the surface of the material being tested. This is not possible in all cases. In correct surface irregularities, use of native fines or sand as a filler is necessary. The depth of the filler should not exceed approximately ¼ in. (3 mm) and the total area filled should not exceed 10% of the bottom area of the gage. Several trial settings may be required to achieve these conditions.

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9.4 Proceed with the test in the following manner:

- 9.4.1 Set the gage firmly.
- 9.4.2 Keep all other radioactive sources away from the gage to avoid affecting the measurement.
- 9.4.3 Secure and record one or more readings for the normal measurement period.
- 9.4.4 Determine the ratio of the reading to the standard count (9.1). From this ratio and the calibration, determine the in-place wet density.

Note 10.—Some instruments have built-in provisions to compute the ratio, compute the in-place wet density, and display it to the operator automatically.

10. Procedure, Method B — Direct Transmission

- 10.1 Standardize the instrument (Section 8).
- 10.2 Select a test location where the gage in test position will be at least 9 in. (230 mm) away from any vertical projection.
- 10.3 Prepare the test site in the following manner:

10.3.1 Remove all loose and disturbed material, and remove additional material as necessary to expose the top of the material to be tested.

10.3.2 Prepare a horizontal area, sufficient in size to accommodate the gage, by planning the area of a smooth condition so as to obtain maximum contact between the gage and material being tested.

10.3.3 The maximum void beneath the gage shall not exceed approximately $\frac{1}{4}$ in. (3 mm). Use native fines or fine sand to fill these voids and smooth the surface with a rigid plate or other suitable tool. The depth of the filler should not exceed approximately $\frac{1}{4}$ in. (3 mm).

10.3.4 Make a hole perpendicular to the prepared surface using the guide and the hole-forming device (7.6.2). The hole shall be of such depth and alignment that insertion of the probe will not cause the gage to tilt from the plane of the prepared area. The depth of the hole must be at least 2 in. (50 mm) deeper than the depth to which the probe will be placed. The guide shall be the same size as the base of the gage, with the hole in the same location on the guide as the probe on the gage. The corners of the guide are marked by scoring the surface of the soil.

10.4 Proceed with testing in the following manner:

- 10.4.1 Set the gage on the soil surface, carefully aligning it with the marks so that the probe will be directly over the pre-formed hole.
- 10.4.2 Insert the probe in the hole.
- 10.4.3 Seat the gage firmly by rotating it about the probe with a back and forth motion.
- 10.4.4 Pull gently on the gage in the direction that will bring the side of the probe against the side of the hole closest to the detector (or source) location in the gage housing.
- 10.4.5 Keep all other radioactive sources away from the gage to avoid affecting the measurement.
- 10.4.6 Secure and record one or more readings for the normal measurement period.
- 10.4.7 Determine the ratio of the reading to the standard count (10.1). From the ratio and the calibration, determine the in-place wet density. If the instrument calculates the wet density, record this value.

11. Procedure, Method C—Air Gap (Optional)

11.1 If the nuclear gage errors due to calibration using materials with different chemical composition are in excess of maximum errors listed in 5.2, the air-gap method should be employed. It should be noted that the required use of two different site measurements may decrease the precision due to the statistics of the air gap measurement.

11.2 Apparatus:

- 11.2.1 All apparatus described in Section 7.
- 11.2.2 Cradle or Spacers, to support the gage at the optimum air gap above the material being tested. The cradles or spacers shall be so designed as to support the gage at optimum height without shielding the base of the gage. Figure 1 shows a typical air-gap cradle that demonstrates the principle. The cradle shown in Fig. 1 is not the only satisfactory method. Other methods which support the gage at the optimum air gap without shielding the base of the gage are satisfactory.

Note 11.—Air-gap calibration curves and optimum air gap may be furnished for each gage by the manufacturer and can be readily checked by the user.

11.3 Determination of Optimum Air Gap—

To determine the optimum air gap for use in the air-gap method, proceed as follows:

- 11.3.1 Use three or more different areas on which to make determinations. These areas

may be either blocks (4.1.1) or field sites of compacted soil or soil-aggregate on which density data have been previously determined (4.1.2) or alternative prepared containers of soil or soil-aggregate compacted to known densities (4.1.2). The density of materials at the selected areas should vary through a range including the densities of the materials which will be tested.

11.3.2 Place the density gage over the test area. Support the gage by blocks placed at the extreme edges of the gage so as not to obstruct the space between the bottom of the gage and the surface of the test area.

11.3.3 Take and record readings for two normal measurement periods in counts per minute and determine the average of the readings.

11.3.4 By adding additional blocks or spacers, increase the air gap by $\frac{1}{4}$ in. (6.3 mm). Take and record, and average readings for two additional normal measurement periods.

11.3.5 Continue increasing the air gap by increments of $\frac{1}{4}$ in., securing average readings for each air gap (11.3.3) until there is a decrease in the counts per minute readings with an increase in air gap.

11.3.6 On an arithmetic scale, plot counts per minute as the ordinate versus each air gap (in inches or millimetres) and draw a smooth curve through the resulting points. Record the peak air gap determined at the peak of the curve.

11.3.7 Repeat procedures 11.3.2 through 11.3.6 over two or more additional areas of materials of different density, and record the peak air gap for each area.

11.3.8 Determine the average of the peak air gaps determined on all areas. This is the optimum air gap. Use the optimum air gap for establishing the calibration curve for the air-gap method, and for all determinations of density by the air-gap method.

11.4 Procedure:

11.4.1 Standardize the instrument.

11.4.2 Select a test location where the gage in test position will be at least 12 in. (300 mm) away from any vertical projection. Plan sufficient area to accommodate the gage and cradle.

11.4.3 Prepare the test site in the following manner:

11.4.3.1 Remove all loose and disturbed material, and additional material as necessary to expose the top of the material to be tested. (See

Note 8.)

11.4.3.2 Prepare a horizontal area, sufficient in size to accommodate the gage and cradle, by planning the area to a smooth condition so as to obtain maximum contact between the gage and material being tested.

11.4.3.3 The maximum void beneath the gage shall not exceed approximately $\frac{1}{4}$ in. (3 mm). Use native fines or fine sand to fill these voids and smooth the surface with a rigid plate or other suitable tool.

Note 12.—The air-gap method requires using one or more readings in both the backscatter position and the air-gap position. The placement of the gage on the surface of the material to be tested is critical to the successful determination of density. The optimum condition is total contact between the bottom surface of the gage and the surface of the material being tested. This is not possible in all cases and to correct surface irregularities use of sand or similar material as a filler is necessary. The depth of the filler should not exceed approximately $\frac{1}{4}$ in. (3 mm) and the total area filled should not exceed 10% of the bottom area of the gage. Several trial readings may be required to achieve these conditions.

11.4.4 Proceed with the test in the following manner:

11.4.4.1 Seat the gage firmly.

11.4.4.2 Keep all other radioactive sources away from the gage to avoid affecting the measurement so as not to affect the readings.

11.4.4.3 Secure and record one or more readings for the normal measurement period in the backscatter position.

11.4.4.4 Place the cradle, set at optimum air gap, on the test site, and place the gage on the cradle so that the gage is directly over the same site used for backscatter reading. When a direct-transmission type gage is used, set the probe in the retracted or backscatter position for this reading.

11.4.4.5 Take the same number of readings for the normal measurement period in the air-gap position as in the backscatter position (11.4.4.3).

11.4.4.6 Determine the air-gap ratio by dividing counts per minute obtained in the air-gap position (11.4.4.5) by counts per minute obtained in backscatter position (11.4.4.3).

11.4.4.7 Determine the in-place wet density by use of the applicable calibration curve previously established.

Note 13.—The air-gap ratio may be determined by dividing counts per minute obtained in the backscatter position by counts per minute obtained in the

air-gap position or vice versa. Whenever ratio is used, a calibration curve using the same ratio must also be used.

12. Determination of Dry Density

12.1 To obtain dry density, use one of the following alternative methods:

12.1.1 If the water content is determined by nuclear methods, Test Method D 3017, subtract the pounds per cubic foot (kg/m^3) of moisture from the pounds per cubic foot (kg/m^3) of wet density, and obtain dry density in pounds per cubic foot (kg/m^3).

12.1.2 If the water content is determined by other methods, such as oven drying, Method D 2216, carbide method, etc., and is in the form of percent, proceed as follows:

$$\rho_d = [\rho_w / (w + 100)] \times 100 \quad (4)$$

where:

ρ_d = dry density, lb/ft^3 (kg/m^3),

ρ_w = wet density, lb/ft^3 (kg/m^3), and

w = percent moisture in the specimen.

13. Report

13.1 The report shall include the following:

13.1.1 Location,

13.1.2 Flowline of surface,

13.1.3 Visual description of material.

13.1.4 Identification of test equipment (make, model, and serial number).

13.1.5 N_m , average of the past four values of N_m taken for prior usage.

13.1.6 N_m , value of the current standardization check (8.3) on the reference standard (7.5), and the method and date of standardization.

13.1.7 Count rate for each reading.

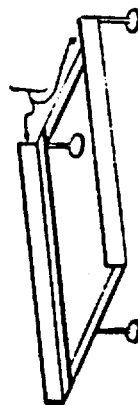
13.1.8 Count ratio.

13.1.9 Wet density.

NOTE 14—The count rate for each reading (13.1.7) and the count ratio (13.1.8) may be omitted from the report for instruments that have built-in provisions to take the ratio, compute the in-place wet density, and display it to the operator automatically.

14. Precision and Accuracy

14.1 The precision and accuracy of this standard has not been determined. No methods are available that provide absolute values of the density of soil or soil-aggregate mixtures in place against which these methods can be compared. The variability of soil does not permit duplication of test results for obtaining a meaningful statistical evaluation. Accuracy is a function of the care exercised in performing the calibrations and steps of the test and of the variability of the material being tested.



Welded metal approx. 1 by 1 by 1/4 in. (25.4 by 25.4 by 3.2 mm) angle.

FIG. 1 Typical Ab-Grip Probe

APPENDIX

XI. NOTES ON THE NUCLEAR TEST

XI.1 The equipment used in this method is of the surface type as opposed to that designed for use in deep borings. In general, and neglecting the associated electronics, this equipment consists of three principal elements: (1) a nuclear source emitting gamma rays, (2) a detector sensitive to these rays as they are modified by passing through the material

being tested, and (3) a counter or scaler with provisions for automatic and precise timing, for determining the rate at which the modified gamma rays arrive at the detector. While rate meters are suitable, in principle, scalars are commonly used. In general, any source of gamma rays that are sufficiently numerous and properly energetic can be used in measuring the

density of soil and soil-aggregate. Source stability with time, in terms of half-life, is an important design consideration and the sources most commonly used are cesium-137 and radium-226. The two detectors most commonly used are gas-filled tubes of the Geiger-Müller type and scintillation crystals, usually of sodium-iodide. Detectors of the latter type offer the potential of electronically varying the range of energies of the gamma rays that are counted. With detectors of the Geiger-Müller type, this range is fixed in the design. For most available equipment, the source-detector geometry is fixed for backscatter gages and is adjustable to various preselected depths of direct transmission gages.

XI.2 Measurements are made using gamma rays that largely reflect at reduced energy by scattering in, or by, direct transmission through the material under test. In backscatter, the rays are emitted into the material from near its surface and some are deflected at reduced energy back to the detector, largely by Compton scattering. In direct transmission the source or detector is inserted in the test materials and, in contrast to the backscatter method, some of the emitted and unshielded rays can presumably follow a straight-line path to the detector. In either source-detector arrangement, the number of rays reaching the detector is, over-all, a nonlinear function of the density of the material being tested. For the usual range of soil and soil-aggregate densities the relationship is such that the higher the density of a given material, the lower the count rate.

XI.3 The determination of density by the nuclear means of this method is indirect. To date no theoretical approach has been developed that predicts the count rate for given equipment, geometry, material, and density. As a result, the relationship between material density and nuclear-count rate is determined by correlation tests of materials at known average densities. Individual equipment manufacturers supply a calibration curve with each set of their equipment. It has been found that these curves do not necessarily hold for all soils and soil-aggregates because of differences in chemical composition. Apparent variations in calibration may also be induced by differences in seating, in background count, and other test variations. Because of these considerations, provisions are included in this method for checking for variations or changes. Different approaches may be used in checking calibration and three in more general use are given. For good practice, these calibration procedures should be followed with newly purchased equipment and with major component replacements of in-service equipment.

XI.4 The density determined by this method is the wet or total density. It should be noted that the volume of soil or soil-aggregate represented in the measurements is indeterminate and will vary with the source-detector geometry of the equipment used and with the characteristics of the material tested. In general, and with all other conditions constant, the more dense the material, the smaller the volume involved in the measurement. The density so determined is not necessarily the average density within the volume involved in the measurement. Although for the usual surface backscatter test equipment and

materials the gages are influenced by 6 to 7 in. (150 to 175 mm) of material, the top 1 in. (25 mm) of the material determines about one half of the measured count rate with the result that the observed density is largely determined by the density of the upper layers. For usual density conditions, the total count is largely determined by the upper 3 to 4 in. (75 to 100 mm) of soils and soil-aggregates. Where these materials are of uniform density, this characteristic of this method is of no effect. With direct-transmission gages the effect of vertical density variations may be eliminated. Other problems, however, can be introduced in the mechanics of inserting the source or the detector.

XI.5 The number of gamma rays emitted from a given source over a given time period are statistically random and follow a Poisson distribution. Because of this, the actual number of modified rays that are detected and counted in the density-measuring process should be sufficiently large to minimize the probability that the observed count reflects unacceptable variations. This is reflected in the standard deviation which is the square root of the total count. The overall system accuracy in determining densities is also statistical in nature and appears to vary with the equipment used, the test conditions of laboratory versus field, as well as with materials and operators. Because of these variables, it is not possible to give precise numbers for system accuracy and precision of these methods. It is believed, however, that if the procedures herein are carefully followed, the standard deviations of the nuclear measured values, in terms of accuracy, will not be greater than on the order of some 3 lb/ft^3 (50 kg/m^3). In terms of precision or repeatability, determined without moving the test equipment, this should not be greater than on the order of 1 lb/ft^3 (20 kg/m^3).

XI.6 One of the most commonly used sources, cesium-137, is man made and as such its use is regulated by the Federal Government through the Atomic Energy Commission as well as by some state and local governments. Because radium is a naturally occurring material, its use is not now regulated by the Federal Government but is by some state and local governments. Among others, the objectives of these regulations are the use of radioactive materials in a manner safe to the operator and all others. Attention is directed to Section 6, Safety Precautions.

XI.7 The in-place nuclear density tests of this method offer several advantages over the older conventional methods (sand-cone, rubber-bulb, etc.), particularly in tests performed for the continuing control of construction. Among these, perhaps the principal advantage is the relative ease with which the test can be performed, thus freeing the operator from the physical tasks of digging holes and collecting and weighing bulky samples. However, it sacrifices the opportunity to examine the soil in depth. If information is sought on in-place densities only, and test determinations of maximum density are not involved, many more tests can be performed per day than by the older methods. In addition, apparently erratic measurements can be immediately detected and checked since the nuclear tests are more nearly nondestructive. These advantages accrue to organi-

zations that are engaged in density measurements on a more or less continuous basis. Organizations that make infrequent or occasional density determinations may find that the advantages of the nuclear method

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not been received or if you have a further comment, you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa 19103.



Designation: D 2936 - 84



Standard Test Method for DIRECT TENSILE STRENGTH OF INTACT ROCK CORE SPECIMENS¹

This standard is issued under the fixed designation D 2936; the number immediately following the designation indicates the year of original adoption or, in the case of revisions, the year of last revision. A number in parentheses indicates the year of last revision. A superscript (s) indicates an editorial change since the last revision or approval.

1. Scope

1.1 This test method covers the determination of the direct tensile strength of intact cylindrical rock specimens.

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Applicable Documents

2.1 ASTM Standards:

E 4 Practices for Load Verification of Testing Machines²

E 122 Recommended Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process³

3. Significance and Use

3.1 Rock is much weaker in tension than in compression. Thus, in determining the failure condition for a rock structure, many investigators employ the tensile strength of the component rock as the failure strength for the structure. Direct tensile stressing of rock is the most basic test for determining the tensile strength of rock.

4. Apparatus

4.1 *Loading Device*, to apply and measure axial load on the specimen, of sufficient capacity to apply the load at a rate conforming to the requirements of 6.2. The device shall be verified

at suitable time intervals in accordance with the procedures given in Practices E 4 and shall comply with the requirements prescribed therein.

4.2 *Caps*—Cylindrical metal caps that, when cemented to the specimen ends, provide a means through which the direct tensile load can be applied. The diameter of the metal caps shall not be less than that of the test specimen, nor shall it exceed the test specimen diameter by more than 0.0025 in. (1.6 mm). Caps shall have a thickness of at least 1 1/2 in. (32 mm). Caps shall be provided with a suitable linkage system for load transfer from the loading device to the test specimen. The linkage system shall be so designed that the load will be transmitted through the axis of the test specimen without the application of bending or torsional stresses. The length of the linkages at each end shall be at least two times the diameter of the metal end caps. One such system is shown in Fig. 1.

NOTE 1—Roller or link chain of suitable capacity has been found to perform quite well in this application. Because roller chain flexes in one plane only, the upper and lower segments should be positioned at right angles to each other to effectively reduce bending in the specimen. Ball-and-socket, cable, or similar arrangements have been found to be generally unsuitable as their tendency for bending and twisting makes the assembly unable to transmit a purely direct tensile stress to the test specimen.

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

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² Annual Book of ASTM Standards, Vol. 01.01, 04.02, 07.01, and 08.01.

³ Annual Book of ASTM Standards, Vol. 14.02.

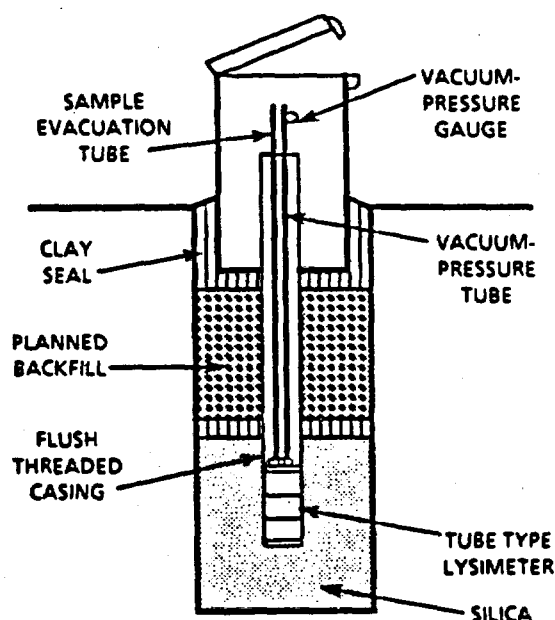
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APPENDIX C

The following installation procedure is inserted as a general guideline for the installation of a teflon vacuum-pressure tube type lysimeter and is not meant to specify or designate the use of Timco manufactured lysimeters. Ebasco does require that an equivalent teflon vacuum-pressure tube type lysimeter should be installed as compared to the one manufactured by Timco.

INSTALLATION OF A TIMCO* LYSIMETER

1. Check to make sure all joints and fittings on the lysimeter and tubes are tight. This can be easily ascertained by immersing the entire unit in distilled water and applying no more than 5 pounds of air pressure. Observe all connections and joints for air bubbles except for the porous filter portion. The porous filter portion should give off bubbles over the entire surface. If any leaks are observed at any point other than the porous filter, the connections should be slightly tightened and checked again. If leaks are still observed, Teflon tape should be used on the threads and the unit re-assembled and checked. Also check for leaks at the plug, stop-cock, clamp, vacuum-pressure gauge or other devices to be used at the top of the tubes at the top of the borehole. It is recommended that prior to installation the lysimeter be submerged in distilled water and a vacuum of 15-20 inches of mercury applied for about one hour. This procedure prewets all surfaces in the porous cup eliminating any entrained air in the porous media.



2. For a two inch diameter lysimeter, drill a six inch borehole or larger. It is recommended that as a minimum there be at least one and one-half inches on each side of the lysimeter for the silica pack. (If difficulties are encountered in maintaining an open borehole, use casing to hold back the

material. After installation of the silica pack and lysimeter, pull back the casing and install a bentonite plug.)

3. Make a slurry of silica using a ratio of 150 ml. distilled water to 450 grams of 200 mesh silica flour; 50-60 pounds of silica flour per lysimeter is suggested (2 gallons water to 50-60 pounds of silica flour). Care should be taken to blend water and silica completely, make certain that no "lumps" exist.
4. Pour part of the silica slurry into the borehole just prior to installation of the lysimeter. (Minimum of 1 1/2 inches in the bottom for tube type, 4 inches for cup type).
5. Place the lysimeter into the borehole, with care being taken to ensure that the lysimeter is centrally located. A minimum of 1 1/2 inches of silica pack around the annular area of the unit is essential. We suggest that the lysimeter be ordered with a threaded top plug which allows for use of TIMCO flush-threaded, deka-lok joint riser pipe with attached centralizers to ensure centering.
6. Pour the balance of the silica slurry around the lysimeter ensuring that the entire unit is completely covered. This will allow for any "settling" or slumping of the silica pack as moisture is withdrawn.
7. Place a bentonite seal above the silica pack followed by tamped backfill. A bentonite surface seal or other type of seal is also recommended. The best of course is a steel security cover with a lock, set in concrete.
8. Clamp off or plug sample evacuation tube. (If Teflon tubes are being used, use a Teflon plug or a Teflon stop-cock, as crimping will do damage to the tube.)
9. Using a vacuum-pressure hand pump or a portable vacuum pump, apply 18 to 21 inches of mercury. We recommend that a stop-cock be installed in the vacuum-pressure line at the surface as well as a vacuum-pressure gauge. If a gauge is not installed, there is no accurate way of determining the amount of initial vacuum or how much vacuum may be left at a later time. A stop-cock ensures no loss of vacuum as the pump is being disconnected, especially with the Teflon tubing, which, as previously mentioned may not be crimped or clamped off without damaging the tube.
10. When the vacuum-pressure gauge indicates less than 10 inches of mercury (approximately 24 hours) sample retrieval should be attempted.

11. **SAMPLE RETRIEVAL OF THE SHALLOW TYPE:** Using a sample flask that is more than adequate for the volume of the lysimeter with a two hole stopper at the top, insert and secure the sample or evacuation tube in one of the holes, making certain that the tube clears the bottom of the stopper by at least 1/2 of an inch. Using another tube of adequate length, attach one end to the vacuum pump and insert the other end of the tube through the other hole in the stopper (have tube flush with bottom of the stopper) and apply vacuum. Vacuum should be repeated until no further sample is obtained. Remove the tubes from the sample flask, repeat procedure numbers 8 through 10. Discard from the first sample or SAMPLES, approximately 30 percent of the volume of the water used to mix the silica pack. Depending upon soil moisture and other factors, the second and subsequent samples may take up to 48 hours or longer to obtain a full sample. A vacuum reading of less than 10 inches will indicate that a sample should be taken. We suggest that the installation be checked every 24 hours.
12. **SAMPLE RETRIEVAL UTILIZING THE TRANSFER VESSEL AT DEPTHS BELOW 20 FEET.** Before installation of the lysimeter attach the transfer vessel 1-2 feet above the lysimeter. Follow procedures 1 through 10. Using a flask that is more than adequate for the volume of the lysimeter, insert and secure the sample or evacuation tube in a vented sample flask. Attach the gas or pressure tank to the vacuum-pressure tube attached to the lysimeter setting the pressure not to exceed 2 1/2 - 5 pounds, forcing the sample into the transfer vessel. By using this amount of pounds of pressure the lysimeter will not be overpressurized causing the silica pack to separate from the Teflon filter. Attach the gas or pressure tank to the second pressure tube which is attached to the transfer vessel. Set the pressure at about 0.42 pounds per foot of depth. Apply pressure until all sample is obtained. Discard from the first sample or samples, approximately 30 percent of the volume of the water used to mix the silica pack. Depending upon soil moisture and other factors, the second and subsequent samples may take up to 48 hours or longer to obtain a full sample. A vacuum reading of less than 10 inches will indicate that a sample should be taken. We suggest that the installation be checked every 24 hours.

NOTE: We further recommend that a 99.5 percent pure silica be used in the silica pack. Chemical analysis of one-half of one percent impurities are available upon request. For critical installations, pure silica is available but is extremely expensive.

NOTE: During installation of PVC body Lysimeters only, we suggest filling the unit with distilled water to overcome the buoyancy factor. This allows the unit to be maintained in a central position within the borehole. Evacuate this water after

the silica slurry has been in place for approximately 30 minutes.

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**FINAL
HEALTH AND SAFETY PLAN**

**WHITMOYER LABORATORIES SITE RI/FS
JACKSON TOWNSHIP, PENNSYLVANIA**

**JUNE 1988
W.A. NO. 200-3L09**

This section contains the Health and Safety Plan (HSAP) for the Whitmoyer Laboratories Site. It is an integral part of the FOP; however, it is designed to function as a stand-alone document as reflected by its internal structure and organization.

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SITE-SPECIFIC HEALTH AND SAFETY PLAN FOR REM III
HAZARDOUS WASTE SITE ACTIVITIES

SITE: Whitmoyer Laboratories

LOCATION: Lebanon County, PA

DATE PREPARED: March 9, 1988

PREPARED BY: Kevin Kenney/NUS Corporation
(NAME/COMPANY)

PLANNED SITE ACTIVITY DATES: June-July, 1988

REVISION: 2

EBASCO SERVICES INCORPORATED, EBASCO SUBCONTRACTORS AND THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY DO NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THIS SITE. DUE TO THE HAZARDOUS NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE, AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS WHICH MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH AND EVALUATION BY TRAINED HEALTH AND SAFETY SPECIALISTS.

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SECTION I: GENERAL

This plan has been prepared in conformance to REM III Program Guideline HS-1.01. It addresses all those activities associated with Remedial Investigation/Feasibility Study (RI/FS)

_____ at the Whitmoyer Lab Site
_____ and will be implemented by the HSO during site work. Compliance with this HASP is required of all persons and third parties who enter this site. Assistance in implementing this Plan can be obtained from the REM III Health and Safety Manager (HSM), and/or the NUS Corporation Company Health and Safety Supervisor (CHSS). The content of this HASP may change or undergo revision based upon additional information made available to health and safety (H&S) personnel, monitoring results or changes in the technical scope of work. Any changes proposed must be reviewed by H&S staff and are subject to approval of the NUS Corporation CHSS, and the HSM.

SITE Whitmoyer Laboratories SITE NO. 1S17

PLAN DATE March 9, 1988

SCOPE OF WORK

Drilling, Surveying, Sampling (Groundwater Sediment, surface water, Biota, Tanks) Test pitting, Well development and purging, and building entr

	<u>SITE MANAGER</u>	<u>HEALTH AND SAFETY OFFICER</u>
NAME	<u>John Trepanowski</u>	<u>Kevin Kenney</u>
WORK PHONE	<u>(412) 788-1080</u>	<u>(412) 788-1080</u>

EMERGENCY PHONE NUMBERS

<u>Myerstown</u>	<u>Police Dept.</u>	<u>(717) 866-5317</u>
<u>Myerstown</u>	<u>Fire Dept.</u>	<u>911</u>
<u>Myerstown</u>	<u>Rescue Service</u>	<u>911</u>
<u>Lebanon Valley</u>	<u>Hospital</u>	<u>(717) 273-8521</u>
<u>Good Samaritan</u>	<u>Back-up Hospital</u>	<u>(717) 272-7611</u>
	<u>National Response Center</u>	<u>(800) 424-8802</u>
	<u>Poison Control Center</u>	<u>(717) 273-8521</u>
<u>Matt Soltis</u>	<u>CHSS</u>	<u>(412) 788-1080</u>
<u>R C Evans</u>	<u>REM III Regional Manager</u>	<u>(215) 752-0212</u>
	<u>Field Operations Leader</u>	
	<u>REM III HSM (G. Smith or J. Janous)</u>	<u>(703) 558-7506</u>
	<u>Community Relations</u>	
	<u>Coordinator</u>	
	<u>Offsite Emergency Services</u>	
	<u>Site Command Post</u>	

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SECTION II: HEALTH AND SAFETY PERSONNEL

2.0 HEALTH AND SAFETY PERSONNEL DESIGNATIONS

The following briefly describes the health and safety designations and general responsibilities which may be employed for the Whitmoyer Laboratories Site.

2.1 COMPANY HEALTH AND SAFETY SUPERVISOR

The CHSS has overall responsibility for development and implementation of this HASP. He also shall approve any changes to this plan due to modification of procedures or newly proposed site activities.

The CHSS will be responsible for the development of new company safety protocols and procedures necessary for field operations and will also be responsible for the resolution of any outstanding safety issues which arise during the conduct of site work. Health and safety-related duties and responsibilities will be assigned only to qualified individuals by the NUS Corporation CHSS. Before personnel may work on site, currentness of acceptable medical examination and acceptability of health and safety training must be approved by the CHSS.

2.2 SITE HEALTH AND SAFETY OFFICER

The HSO will be present on site during the conduct of all Level A, or B, or high-hazard Level C field operations and will be responsible for all health and safety activities and the delegation of duties to the H&S staff in the field. Where the site is identified as low-hazard Level C or Level D, the HSO may direct the site health and safety efforts through an assistant health and safety officer approved by the CHSS. The assistant will be responsible for implementation of the HASP. He may direct or participate in downrange activities as appropriate when this does not interfere with his primary HSO responsibility. The HSO has stop-work authorization which he will execute upon his determination of an imminent safety hazard, emergency situation, or other potentially dangerous situations, such as detrimental weather conditions. Authorization to proceed with work will be issued by the CHSS after such action. The HSO will initiate and execute all contact with support facilities and personnel when this action is appropriate.

2.3 ASSISTANT HEALTH AND SAFETY OFFICER

An Assistant HSO may be designated. On low-hazard Level C or Level D site he may have collateral duties but must be qualified for the health and safety responsibility by the CHSS. At Level A, B or high-hazard Level C site, he will be the downrange person who accompanies field sampling teams and will report to the HSO. Additionally, he may be required to support the HSO when multiple operations are conducted that require monitoring

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and HSO surveillance. His primary responsibility is to provide the appropriate monitoring to ensure the safe conduct of field operations. He will have access to continuous communications with the Command Post. The number of Assistant HSO's will be dependent upon the number of downrange operations occurring simultaneously, site level of protection designation, and the individual assignments made by the HSO. The Assistant HSO will also share responsibility with the Field Operations Lead and the HSO for ensuring that all safety practices are utilized by downrange teams and that during emergency situations appropriate procedures are immediately and effectively initiated. He will also be responsible for the control of specific field operations and all related activities such as personnel decontamination, monitoring of worker heat or cold stress, distribution of safety equipment, and conformance with all other procedures established by the HASP.

2.4 AIR MONITORING SPECIALIST

The Air Monitoring Specialist, if needed, will perform all supplemental air monitoring necessary to support specific activities as required by the HASP. These activities will include operations where special problems exist, extensive instrumentation is required, or particularly complex operations are planned. He will provide consultation to the project team where such services are necessary to ensure that appropriate monitoring, calibration, and maintenance procedures are employed. This will include specification as to type of instrumentation and procedures to be employed to make sure of its proper use.

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SECTION III: SITE HISTORY AND PHYSICAL DESCRIPTION

3.1 LOCATION

The Whitmoyer Laboratories site is located on approximately 20 acres in Jackson Township, Lebanon County, PA, about one mile southwest of the city of Myerstown. The site lies between the Union Canal of Tulpehocken Creek and the Conrail (Reading) Railroad (see Figure 1). Fairfield Avenue forms the site's eastern boundary, while Creamery Street adjoins the site to the west.

Land surrounding the site is predominantly farmland, with farmhouses scattered around the area. A Sterling Drug factory is located immediately east of the site, while PJ Valves is located about 1500 feet to the south. A calcite quarry is located approximately 1.5 miles west of the site.

3.2 DESCRIPTION

The site borders Tulpehocken Creek, approximately 37 miles upstream of the confluence with the Schuylkill River and about 16 miles upstream from the Upper End of the Blue Marsh Dam project. Womelsdorf is the first town downstream, at a distance of approximately 4 miles.

The headwaters of the section of Tulpehocken Creek which passes by the site originate approximately 3 miles to the northwest. The Creek is formed by springs and runoff from Blue Mountain.

The Tulpehocken Creek drainage basin covers 211 square miles and is 33.5 miles long, with an average bed slope of 0.0015. The average annual creek flow is 200 cfs, with the maximum flood flow (as of 1969) being 9890 cfs on December 7, 1953. The general direction of stream flow follows on the east-northeast strike of the carbonate bedrock.

Creek flow at the site is supplemented by pumping from the large active limestone quarry west of the site. When the quarry was completely pumped down in the early 1980's, the quarry discharge accounted for about three-quarters of Tulpehocken Creek's baseflow at the site.

The quarry's new ownership has allowed the quarry to partially fill. The quarry water level (and pumping rate) is now dependent on what portion of the quarry needs to be accessed for ongoing operations.

Tulpehocken Creek is used extensively for recreation and fishing within 3 miles of the site. Above the site the creek supports a native brown trout fishery. At the site and downstream, white suckers and some carp survive year-round. Additionally, this stretch of creek is stocked with catchable trout three times a

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year. The trout and possibly the carp and suckers are consumed by humans.

There is a possibility that some of the planted trout survive through the fishing season living next to cold springs. However, this possibility is considered slim, due to the warmth of the stream water at and below the site.

Approximately seven miles downstream of the site, Tulpehocken Creek is impounded by the Charming Forge Dam. The lake behind the dam has filled with sediments to a point where the creek is flowing directly over the crest of the dam. Charming Forge Lake is actively fished for bullhead and carp. Some of these fish are believed to be consumed.

Blue March Lake, a warmwater lake, supports an active bass and panfish fishery. These fish are likely consumed.

The tailwater section of Blue Marsh Dam supports an active trout fishery. Trout fishing along this creek stretch has received national attention.

There are several ponds and quarries in and around Myerstown which are fed by ground water. Included in this list are the Myerstown Pond, a two-acre community lake, the Lakeside Quarry on the east end of Myerstown, two smaller quarries on the Wenger property near Race Street in Myerstown, and a quarry west of the Kreider property and the site. Catfish, bluegills and bass are probably present in the Myerstown Pond. Lakeside Quarry is stocked with finerling trout by the Pennsylvania Fish Commission. The two Wenger quarries, which are private, have bass and panfish in them. The same situation is probably true for the quarry west of the Kreider property.

3.3 HISTORY

The earliest activity at the site occurred in the early 1900's, when an oil pipeline was constructed across the site. Onsite storage tanks were also part of the pipeline's operations. This activity probably was performed by Tuscarora Oil Company or a predecessor.

In September, 1934 C W Whitmoyer formed Whitmoyer Laboratories, Inc. (WLI) by merging his operations with another animal pharmaceutical company. WLI filed to do business in Pennsylvania in the following months. Little documentation of WLI operations prior to 1957 exists. Aerial photography indicates that some sort of production was occurring, but no records regarding feedstocks, products and/or quantities were identified.

Aerial photography from 1951 indicates that some unspecified activity was occurring at the site. At this time Buildings 1-5 had been constructed, as were the tanks located to the south of Buildings 4 and 5. Additionally, mounded material, a probable

pit, and possible drums were identified. Also, construction work along the pipeline had recently occurred, and a rail spur to the site was being constructed. Finally, the two large dikes which were later utilized as lagoons were evident.

In 1957 the production of organic arsenicals reportedly commenced at the site. Two primary products, arsanilic acid and carbarsone (p-ureidobenzeneearsonic acid), were manufactured. The primary organic chemical used was aniline. Coal tar dip, piperazine, sulfa products, biodin and ethylenediamine dihydroiodide (EDDI) were also produced in 1964. Wastewater from all of these processes was routed to an unlined lagoon which was constructed inside of the easternmost dike previously emplaced around an oil storage tank. The lagoon was constructed directly on top of bedrock.

Lime was added to the process wastewater to precipitate arsenic. The arsenic precipitate consisted of calcium arsenate, calcium arsenite, and organically-bound arsenic. Estimates of the quantity of arsenic placed in the unlined lagoon range as high as 4,000,000 pounds or more. The lagoon occupied the same area as the consolidated lagoons shown on Figure 1.

In 1964 WLI was bought by and became a wholly-owned subsidiary of Rohm and Haas (R&H). In September 1964 an R&H official first identified the arsenic pollution problem caused by wastewater disposal in the unlined lagoon. Significant soil, surface water and ground water contamination was identified.

Surface water at the site assayed at 40-60 mg/l arsenic. Approximately 1900 to 3200 pounds of arsenic per day were leaving the site in surface water. Arsenic contamination was traced from Tulpehocken Creek/Union Canal as far as the Schuylkill River-Delaware River confluence in Philadelphia.

Ground water arsenic contamination reached 10,000 mg/l onsite. Over thirty residential wells in the vicinity of the site were found to be contaminated with high levels of arsenic. At least two individuals were reportedly hospitalized with chronic arsenic poisoning from ingestion of their well water. The area of ground water pollution was approximately one mile wide by six miles long, extending in all four directions from the site.

Once this contamination was identified, a three-pronged remediation effort was initiated. This effort consisted of:

- Excavation of lagoon sludges and other hot spots.
- Ground water pumping and treatment
- Supply of bottled water to nearby residents with contaminated wells.

At the same time (late 1964), R&H temporarily ceased operations, waiting until the contamination problems had been sufficiently addressed before resuming production. In the spring of 1965 production of organic arsenicals and other chemicals at the

Whitmoyer plant was resumed on a no-arsenic-discharge basis. Treated arsenic wastes were trucked to Paulsboro, New Jersey and dumped in the ocean.

A concrete vault measuring 123 feet long by 83 feet wide and 12 feet deep was constructed to accept the lagoon sludges and other contaminated material. The walls were coated with a bitumastic sealant. An estimated 3.75 million pounds of arsenic were placed in the vault.

Two separate scattered piles of diamino diphenyl arsonic acid, (DDAA), a waste product which was being held for later arsenic recovery, were located on the property. These piles, which weighed about 2 million pounds, were also excavated and drummed as part of the cleanup effort. The drums were temporarily stored offsite in a barn until 1968. The final fate of this material was not identified. Records showed that R&H conducted bench-scale tests evaluating the feasibility of recycling this material. About 250 drums of contaminated soil underlying the DDAA stockpile were deposited in the vault.

As part of the cleanup, 1455 drums probably containing aniline still bottoms, which had been deposited at the nearby Schaefferstown quarry were removed from the quarry back to the site. This material was reportedly placed in the vault.

The extraction and treatment of contaminated ground water was initiated concurrently with the excavation project, i.e., in December 1964. Initially four previously abandoned wells were used to extract the contaminated ground water. Weekly yields of arsenic peaked at 11,000 pounds early in the project, and quickly fell to 4,500 to 5,000 pounds by April, 1965. Three additional extraction wells were brought onstream in June 1965, bring the extraction rate up to 70 gpm, but arsenic yields continued to gradually decrease. Seven additional recovery wells were drilled and activated by the end of 1966, increasing the extraction rate to 140 gpm. While these additional wells increased arsenic production in the near term, the well yields eventually decreased again, to a level of 500 to 700 pounds per week by April 1968. The cumulative amount of arsenic extracted in the ground water by the end of 1968 was 400,000 pounds. No comparable figures for aniline or other contaminants are available, as these were not contaminants of concern at that time and were not analyzed.

The extracted water was treated with ferric sulfate and flocculant to precipitate ferric arsenate. The ferric arsenate was allowed to precipitate in the existing lagoons, which had been compartmentalized into eight lagoons and refurbished. Additional lagoons were also constructed to provide added settling capacity. Some of these lagoons were lined with six inches of topsoil, while others were lined with six to eight inches of clay. When completed, the lagoons covered approximately 2.5 acres.

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With the exception of the thin liner, no effort was made to keep the treated wastewater from reentering ground water. In fact, it was encouraged so that greater pumping rates could be achieved without necessitating a discharge to the sewer or surface water. During the pump and treat program an estimated three pounds of arsenic per day was reentering ground water via infiltration from the lagoons.

Due to the cost of ground water treatment, the desire to expand the cone of depression of the pumping network (by limiting reinfiltration), the desire to minimize the accumulation of arsenic precipitate, and the lower concentration of ground water being pumped, R&H petitioned and received permission to discharge extracted ground water directly to Tulpehocken Creek in December 1968. Direct discharge commenced shortly thereafter. This discharge was temporarily halted in April 1969 but reinitiated the following September.

In 1970 a program of overstressing was attempted to assist flushing of contaminants from the subsurface. This program consisted of ponding Union Canal water on the lagoons, municipal water near well #3, and spent cooling water (in a trench) near well 7, and allowing these waters to infiltrate to the subsurface. As arsenic yields did not significantly increase with this approach, it was abandoned shortly thereafter.

In March 1971, because of public and regulatory opposition to continued untreated discharge of contaminated ground water to Tulpehocken Creek and R&H's resistance to resume ground water treatment, R&H ceased operation of their pumping wells. Reportedly 50,000 pounds of arsenic was extracted and discharged to Tulpehocken Creek from December 1968 until pumping was halted. The discharge rate was as high as 250,000 gpd during this period.

Adding the 50,000 pounds of arsenic removed from December 1968 until the March 1971 end of pumping to the amount removed from December 1964 through December 1968 gives a total of 450,000 pounds of arsenic removed from ground water during the extraction program.

In 1965, R&H also conducted an augering and coring program to evaluate the arsenic concentration of subsurface soil and rock. As expected, with arsenic's strong affinity for soil adsorption, the lower layers of the soil mantle (which were in contact with ground water) had accumulated significant amounts of arsenic (the available 1965 analytical results for the soil directly above bedrock averaged 1,500 mg/kg). Most of this accumulation had occurred around and along the contact surface between the soil mantle and the underlying rock formations. The majority of this contamination is reportedly localized within the plant boundaries. The soil's arsenic accumulations were later confirmed during a 1973 United States Geologic Survey (USGS) study. A study conclusion was that the majority of the arsenic

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in the soil in 1965 had remained there through the pump and treat program.

In 1970 R&H amended their process for producing arsanilic acid. At this time, perchloroethylene (PCE) was introduced as a process chemical at the plant.

In March 1971 public opposition to ocean dumping of the plant wastes caused R&H to abandon this disposal method. Since R&H had no way of disposing its waste solutions, production of arsanilic acid and carbarsone were temporarily suspended. In 1972, R&H introduced a process whereby they evaporated (boiled) the waste solutions, followed by centrifuging and drumming the waste for landfill disposal offsite. When this was approved, production commenced once again.

In late 1976 and 1977 R&H consolidated the lagoon sludges. Approximately 350,000 pounds of arsenic was contained in the sludge which was excavated from the westernmost lagoons (1, 2, 3, 4, 13, 14, and 15) and placed in the easternmost lagoons (5 through 12-see Figure 1). The consolidation raised the receiving lagoons' height from five to eight feet on average.

Due to the crevices in the bottoms of the abandoned lagoons, complete removal of the sludge was impossible. To restrict movement of the remaining material, R&H placed a 1/4 to 1/2-inch thick layer of bentonite over the excavated lagoons. The bentonite was wetted and covered with 1.5 to 2 feet of earth. Following cover placement, the earth was seeded to prevent erosion.

No records revealing the nature of the cover material used for the consolidated lagoons were identified. During the site visit it was observed that the area was well vegetated. The USEPA Technical Assistance Team (TAT) reported that a red clayey capping material up to three feet thick was indicated when an augering program was conducted in the lagoon area during July 1987.

During the week of May 17, 1976, the USEPA Annapolis Field Office, with assistance from PADER, conducted an investigation of the Myerstown Sewage Treatment Plant. The primary study objective was to determine the pollutants and their sources interfering with the plant's operations and causing the plant's discharge limitations for arsenic and other criteria to be exceeded. Six industrial sewer discharges, including Whitmoyer's, were sampled. An arsenic materials balance indicated that nearly 94 percent of the arsenic load reaching the plant was not attributable to the industrial discharges. It was concluded that contaminant infiltration through cracked sewer lines was the probable source.

Following this conclusion, WLI conducted additional studies and discovered several infiltration points on their property. Most, if not all, of these leaks were repaired.

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In the mid-70's WLI was required to get an air permit for their discharge of contaminants from their evaporation wastewater treatment process. Contaminants of concern that WLI monitored included arsenic and aniline (some of the arsenic products, e.g., alkyl arsines, were volatile).

In the summer of 1978 a portion of the stack emissions condensed and dropped out in the nearby farmers' fields. This fallout damaged one farmer's corn crop planted directly east of the site. It is believed that arsenic was the contaminant which damaged the corn. Cattle were reportedly attracted to the fallout areas because of the high salt content.

In 1978 Beecham Labs of Clifton, New Jersey purchased Whitmoyer Laboratories from Rohm & Haas. The plant managerial staff for the Myerstown plant remained essentially intact.

In 1979 Buckeye Oil Company repaired a section of pipeline running through the site. In the course of these repairs, underground excavations uncovered a burial ground containing arsenical waste products. It is thought this area was used as a small dumping ground and covered over around 1958 or 1959. The burial area was approximately 30 feet by 40 feet and about 7 feet deep. This area was excavated and disposed offsite.

On May 14, 1982 Beecham sold Whitmoyer to Stafford Laboratories, Inc. of Phoenix, Arizona. Again the plant managerial staff remained essentially intact.

In July to November, 1982 concern about arsenic and organic contaminants leaving the property was raised, and a small pump program using only well 7 was initiated. This water was pumped from the well into a special heated truck and evaporated. From program inception to completion aniline concentrations decreased, but arsenic and PCE concentrations did not. Since the arsenic and PCE concentrations did not decline the program was halted in November.

On February 22, 1983 Whitmoyer Laboratories submitted a RCRA Hazardous Waste Treatment and Storage Closure Plan to PADER. This closure plan only related to the then-current hazardous waste activities. Following implementation of the plan, Whitmoyer was no longer to treat and store hazardous waste, except within the 90-day storage limit for a RCRA hazardous waste generator, i.e., wastewater evaporation was to be discontinued. At the same time Whitmoyer sought a RCRA hazardous waste generator status.

On February 9, 1984 USEPA's TAT conducted an assessment of the Whitmoyer site. Samples for arsenic were collected from Tulpehocken Creek both upstream and downstream of the site, from Union Canal on the site property, from onsite wells 4 and 7, and from a nearby residential well. Elevated levels of arsenic were detected in the downgradient surface water and sediment and

onsite monitor well samples. The results are discussed in Section 5 below.

During the TAT investigation, organic vapors were detected by a photoionization detector. To confirm organic contamination, TAT again sampled on February 17, 1984.

During this sampling event samples were again collected from wells 4 and 7 and from liquid and sediment present in a borehole located adjacent to the vault. The samples were analyzed for aniline, volatiles and base/neutral extractable compounds. Elevated levels of organics were detected in all of these samples.

In January 1984 WLI developed a process to produce chlorhexidine. The records do not indicate whether production actually occurred or not.

Stafford Laboratories filed for bankruptcy in the summer of 1984.

In 1985 and 1987 the PADER Bureau of Environmental Control sampled nearby residential wells for volatile organics and arsenic. Elevated levels of arsenic, PCE, trichloroethylene (TCE), 1,1-dichloroethene, cis-1,2-dichloroethylene, 1,1,1-trichloroethane, and toluene were detected.

The WLI plant reportedly last operated in January of 1987. These operations were said to be only of a limited scale.

In February, 1987 USEPA's Environmental Response Team (ERT) sampled two bodies of water of interest, the Myerstown Pond and an unidentified quarry east of Myerstown, for arsenic. The samples contained arsenic in concentrations lower than the present Primary Drinking Water Standard.

In July, 1987 USEPA's TAT sampled offsite surface and subsurface soil, soil from the banks of Union Canal, the lagoon sludge, the vault contents, and surface water and sediment from Union Canal and Tulpehocken Creek for arsenic. Elevated levels were detected in the lagoon, vault, offsite soils and downgradient surface water and sediment samples.

Also in July 1987, the TAT conducted ground penetrating radar (GPR) and magnetometer surveys of the lagoon areas to determine the lagoons' volumetric extent and if buried drums were present in the lagoons.

On November 4 and 5, 1987, USEPA's TAT sampled 24 offsite residential and industrial wells for VOA's and arsenic. Elevated levels of arsenic, PCE, TCE, 1,1-dichloroethane, and 1,1,1-trichloroethane were detected in several of the wells.

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SECTION IV: SITE RELATED INCIDENTS, COMPLAINTS, AND ACTIONS

See history section III. 3.3.

SECTION V: WASTE DESCRIPTION/CHARACTERIZATION

5.1 The following information is presented in order to identify the types of materials that may be encountered at the Whitmoyer Labs Site. The detailed information on these materials was obtained from Fundamentals of Industrial Hygiene 2nd ed. and NIOSH Pocket Guide to Chemical Hazards

5.2 CERCLA HAZARD RATING DEFINITIONS

<u>Substance</u>	<u>Toxicity</u>	<u>Ignitability</u>	<u>Reactivity</u>	<u>Persistence</u>
Arsenic	3	1	0	1
Aniline	3	2	0	1
Perchloroethylene	2	0	0	2
1,1-dichloroethane	2	0	0	2
trichloroethylene	2	1	0	1
1,1,1-trichloroethane	--	--	--	--
Copper	2	0	1	1
Toluene	2	3	0	1
Methylene Chloride	2	0	0	0

-- not listed

5.3 WASTE TYPES: Liquid X Solid X Gas _____
 Sludge X Semi-solid _____ Other _____

5.4 CHARACTERISTICS: Corrosive X Flammable _____
 Explosive _____ Volatile X _____
 Radioactive _____ Inert _____
 Other _____

5.5 CONTAINMENT: Pit X Pond _____ Lagoon X _____
 Lake _____ Process Vessel _____
 Tank X Piping _____ Drum X _____
 Tank Car _____ Lab Pack _____
 Other X _____

5.6 DESCRIPTION OF "OTHER" FOUND IN 5.3, 5.4, AND 5.5.

Vault

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SECTION VI: HAZARD ASSESSMENT

The hazard evaluation for site activities will change with each task and job site on this project. The biggest concerns at the Whitmoyer Site are arsenic and aniline. The greatest potential for contact with these chemicals will occur during drilling, test pitting, and the building entry tasks. Employees present at this site are to follow all safety concerns outlined in this HASP to minimize any exposure problems that may present themselves.

Personnel shall familiarize themselves with the contaminants present on site and the explanation of them that follows. Personnel are also advised that certain activities may include entering buildings. These have recently been occupied so it is assumed they are structurally sound. (The HSO shall certify this prior to entering any process building.)

Arsenic

Arsenic is recognized by OSHA and the American Conference of Governmental Industrial Hygienists (ACGIH) as suspect human carcinogens causing cancers of the lung and skin. The inorganic arsenic forms are considered to pose the greatest carcinogenic risk, with the organic forms at a reduced risk.

The primary routes of exposure to arsenic and its compounds are via inhalation and skin absorption/contact. Thus to protect exposed personnel from the potential acute/chronic effects from arsenic, the use of the appropriate personal protective equipment is required. Additionally to eliminate the risk of ingestion, the establishment and following of good personal hygiene practices is required.

The acute effects noted from arsenic include eye, nose, and throat irritation, pulmonary edema, coughing, chest pain, nervous system impairment, gastrointestinal discomfort, diarrhea, and loss of hair. The chronic effects in addition to lung and skin cancers include: nasal ulceration, hoarse voice, gastrointestinal disturbances (nausea, vomiting) nervous system effects involving the extremities, blood disorders, and kidney and liver damage.

The present OSHA permissible exposure limit for all forms of airborne inorganic arsenic is $10 \mu\text{g}/\text{m}^3$. This level is established to minimize the carcinogenic risks. OSHA has also established an action level of $5 \mu\text{g}/\text{m}^3$ at which medical surveillance among others are required, once 30 days of exposure to arsenic is exceeded.

The present ACGIH TLV of $0.2 \text{ mg}/\text{m}^3$ is the recognized limit for airborne exposures to organic forms of arsenic (i.e., arsenic and soluble compounds). The ACGIH TLV for arsenic trioxide production listed as an A-2 carcinogen is not applicable for this work site.

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Aniline

Aniline or Phenylamine, a high-boiling flammable liquid, can be readily absorbed through the unbroken skin. Poisoning can also occur from inhalation of the vapor and from swallowing the liquid.

It is primarily a blood and nervous system poison. The most notable signs of poisoning are rapid breathing followed by blue color (particularly of the lips, ears, and fingertips), shuffling, staggering gait, and fixed, hesitant speech. Extremely severe poisoning may cause tremors or convulsions and arrest of respiration. If the clothing is saturated with aniline, the symptoms of acute poisoning may appear with remarkable suddenness. Aniline poisoning may seem so sudden because the early stages are without symptoms, except for the blue color of the lips. Poisoning may be advanced and the individual still show no signs except for this color. The first subjective sign is usually a severe, persistent headache.

Persons who display symptoms of aniline poisoning without having had skin contact with the liquid should be removed to fresh air immediately, given a mild stimulant such as black coffee (never alcohol), and kept quiet and warm. They should be put under medical supervision and kept under observation for some time, since the symptoms occasionally recur. If breathing has stopped, artificial respiration should be applied.

Floor and workrooms where aniline is to be handled should be impervious, and the operations should be enclosed as much as possible and locally exhausted. Workrooms should be kept scrupulously clean.

Workers should have clean clothing for every shift and should immediately change clothing which becomes saturated with aniline. Even a single glove or a part of a shoe saturated with aniline may cause severe poisoning.

Short exposure tolerance is uncertain, but probably 50 to 100 ppm can be tolerated for 60 minutes. This depends on the extent of skin contact and also upon the susceptibility of the individual.

A TLV of 2 ppm is recommended to prevent significant formation of methemoglobin.

This project consists of a number of tasks, a breakdown of each along with the associated hazards involved with these follows. For a description of the protective clothing to be worn please see Section 8.2.2.

300710

Mobilization/Demobilization - Very low hazard involved with this test. Remain out of buildings and water physical hazards - Level D.

Surveying - Same as Mobilization/Demobilization.

Drilling - High hazard involved because of the increased particulate levels created by drilling, and the possibility of aniline and arsenic being released while drilling through soils. If dusty conditions are present personnel will wear level C respiratory protection with a particulate and organic vapor cartridge. If readings above background are noted on the HNU, however, personnel will need to be in Level B self contained breathing apparatus (SCBA), because cartridges are not available to prevent exposure to aniline. Most always wear the appropriate dermal protection noted in Section 8.2.2.

Test Pitting - High hazard involved because of the aniline and arsenic present in soils. If readings elevate above background personnel must go to level B (SCBA) protection, again because of no cartridge being available for aniline exposure. Must wear appropriate dermal protection noted in Section 8.2.2.

Sampling - Same as Test Pitting.

Biota - Same as Test Pitting.

Building Entry - Very high hazard because buildings have been closed for a period of time and opening them may stir up particulates. Organics may have also built up within them. Personnel must wear level B (SCBA) respiratory protection and the appropriate dermal protection upon initial entry into these buildings until sampling can determine concentrations and contaminants within.

Development and Purging - Same as Drilling.

300711

SECTION VII: TRAINING

7.0 BASIC TRAINING REQUIRED

Completion of the REM III Fundamental Health and Safety Training or the approved equivalent is required for all employees who will perform work in areas where the potential for a toxic exposure exists. Training or training and site experience must also conform to the requirements of 29 CFR 1910.120.

7.1 ADVANCED TRAINING

Advanced Training as necessary will be provided to any personnel who will be expected to perform site work utilizing Level A protection or other specialized operation to be undertaken at a site. An Emergency Response Team shall be formed and trained to carry out Level A work.

7.2 SITE-SPECIFIC TRAINING

Training will be provided that will specifically address the activities, procedures, monitoring, and equipment for the site operations. It will include site and facility layout, hazards, and emergency services at the site, and will detail all provisions contained within this HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

7.3 SAFETY BRIEFINGS

Project personnel will be given briefings by the HSO or Assistant HSO on a daily or as-needed basis to further assist site personnel in conducting their activities safely. It will be provided when new operations are to be conducted, changes in work practices must be implemented due to new information made available, or if site or environmental conditions change. Briefings will also be given to facilitate conformance with prescribed safety practices when performance deficiencies are identified during routine daily activities or as a result of safety audits.

7.4 FIRST AID AND CPR

The CHSS will identify those individuals requiring this training in order to ensure emergency treatment is available at field activities. It is expected that the selected number of field workers will have First Aid training and several members of the field team will have CPR training. These courses will be consistent with the requirements of the American Red Cross Association.

300712

7.5 OTHER TRAINING

None required.

SECTION VIII: ZONES, PROTECTION, AND COMMUNICATION

8.1 SITE ZONES

Because of the site location and the high number of work areas to be initiated, zones will have to be included with each task. The three zones that must be set-up include: the support zone (clean), contamination reduction zone (CRZ) (Clean), and exclusion zone (EZ)(dirty). With each work site start-up the (EZ) and (CRZ) must be delineated and explained to workers. The (EZ) will be the area where actual work will commence, entry into this zone will require the full protective gear designated for the given task at hand. Outside of this zone will be the (CRZ) which will maintain the equipment and personal decontamination areas. Beyond that area will be the Support Zone which is an area set-up for the location at such things as supplies, the trailer, a shipping area, etc. This area is to remain clean, and at no time shall personnel enter the support zone from the (EZ) without properly deconning first. Please see the following page which is (Exhibit-S0-4) a generic map showing the zones and a sketch of the possible set-up.

300713

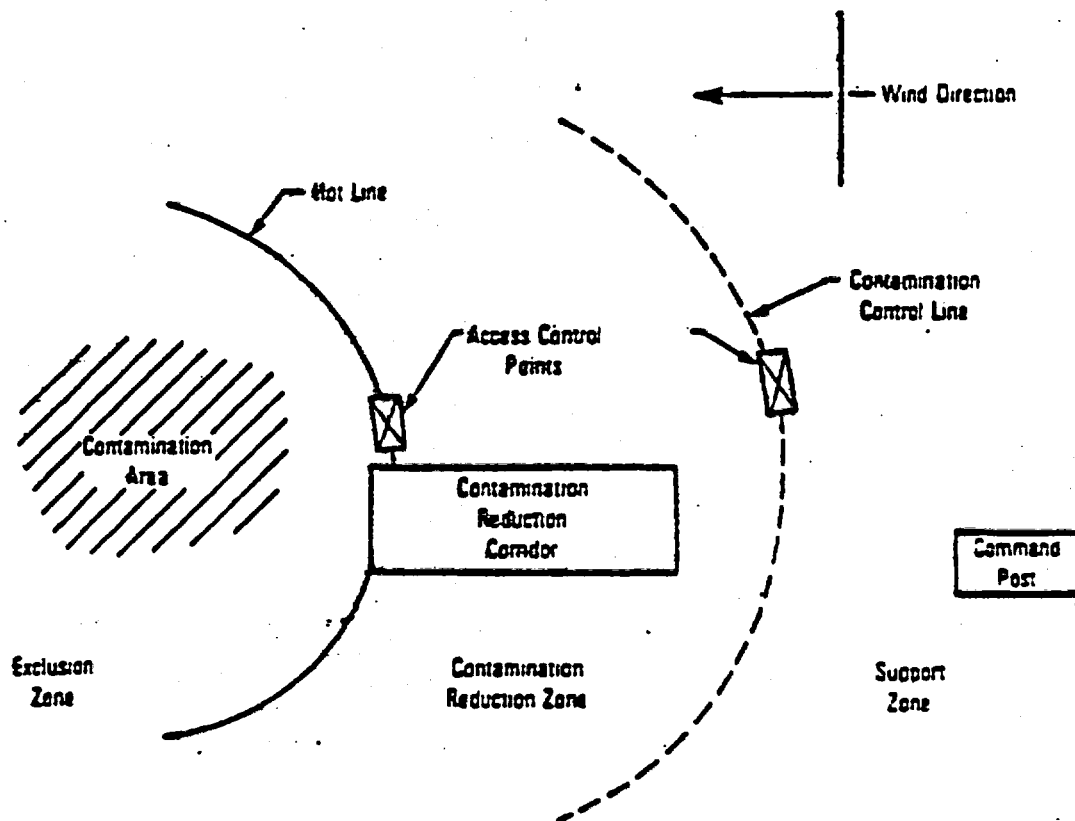


EXHIBIT SO-4. DIAGRAM OF SITE WORK ZONES

300714

8.2.1 General

[illegible]

-21-

8.2.2 Initial Levels of Protection

Initial levels of protection will be employed during the performance of the Initial Reconnaissance. The recon team is anticipated to consist of a minimum number of personnel. The HSO, the Site Manager, or Site Project Engineer, and other appropriate support personnel may be required. The team will enter hazardous areas and spill locations in conservatively-specified protection with appropriate monitoring equipment. The Initial Reconnaissance will allow for the selection of appropriate protection levels for planned operations, decontamination procedures, site layout, sampling strategies, and general safety planning. It should be noted that this HASP allows for upgrading or downgrading of protection levels to conservatively preclude any potential for contamination while not sacrificing protection or efficiency. During the Initial Reconnaissance, the team will perform various monitoring techniques to identify the presence of contaminants as well as assessing the integrity of the site in consideration of safety for the proposed site investigation, sampling, or construction operations. Careful attention shall be paid to conform to requirements of 29 CFR 1910.120(c) relating to Site Characterization and Analysis.

Initial levels of protection for mobilization of site work will be Level D, except for the entrance of buildings on site to take samples of air quality, which will be in Level B Self Contained breathing apparatus (SCBA). The following is the protection required for each task found in Section 8.2.1.

Mobilization/Demobilization -

Level D Standard work clothes*.

Surveying - Same as above.

Drilling - See Section VI for respiratory protection rationale, clothing will include PE coveralls w/hoods, Neoprene after gloves, survey inner gloves, boot covers, and standard work clothes*.

Test Pitting - Same as Drilling.

Sampling - Same as Drilling.

Biota - Same as Mobilization/Demobilization.

Building Entry - Same as drilling.

Well development and purging - Same as drilling.

*Standard Work Clothes - Hard hat, steel toe/shank boots, safety glasses with side shields, and TLD Badge.

300716

8.2.3 Safety Equipment

Basic emergency and first aid equipment will be available at the Support Zone and/or the CRC, as appropriate. This shall include HASP-specified communications, first aid kit, emergency eyewash or emergency shower or drench system, fire extinguisher, and other safety-related equipment. Also located in the Support Zone or the CRZ will be a backup field team when required to support downrange field teams. The Command Post will be manned during all times when teams are downrange, communications will be maintained, and personnel will be available to assist in decontamination procedures for personnel and equipment. Other safety equipment will be located at the site of specific operations, e.g., a drilling rig, as appropriate.

At all times when personnel are in level C or B respiratory protection a 5-minute escape pack shall be available for emergency escape.

8.3 COMMUNICATIONS

- Walkie-Talkies - Hand held units shall be utilized as much as possible by field teams for communication between downrange operations and the Command Post base-station.
- Telephones - A telephone may be located in the Command Post trailer in the Support Zone for communication with emergency support services/facilities. If not appropriate for a particular project, the nearest public phones shall be identified.
- Air Horns - These will be carried by downrange field teams and also will be maintained at the Support Zone for announcing emergency evacuation procedures (see Section XIV) and backup for other forms of communications.
- Hand signals - To be employed by downrange field teams along with utilizing the buddy system. These signals are also very important when working with heavy equipment. They shall be known by the entire field team before operations commence and covered during site-specific training.

200717

300717

SECTION IX: MONITORING PROCEDURES

9.1 MONITORING DURING SITE OPERATIONS

All site environmental monitoring should be accompanied by meteorological monitoring of appropriate climatic conditions.

9.1.1 Drilling Operations - Monitoring will be performed continuously by the HSO during the conduct of work. A photoionization detector (PID) and/or flame ionization detector (FID) equipped organic vapor meter will be utilized to monitor the breathing zone, the borehole, and all geological samples upon their retrieval. Drill cuttings will also be monitored. A combustible gas indicator (CGI) with oxygen alarm will be used to monitor the borehole for the presence of combustible gases. Similar monitoring of any fluids produced during well development will also be conducted.

9.1.2 Excavation Operations - Monitoring will be performed continuously during all excavation and sampling operations. A PID and/or FID organic vapor meter will be utilized to monitor the breathing zone, the excavated area, any any material taken from an excavation. Monitoring of the excavation with a CGI and oxygen meter will be conducted.

9.1.3 Other Operations - All tasks will try and minimize soil disturbance which would increase airborne particulates.

Building entry - use of FID or PID instrument during entrance is required.

All instruments shall be calibrated prior to leaving for the project by Mr. Tom Patton equipment manager, Pittsburgh and after every 3 days of field use thereafter.

NIOSH-Approved sampling methods will be used to be determined building concentrations of aniline and methyl bromide, prior to the beginning of work inside.

300718

9.2 PERSONNEL MONITORING PROCEDURES

During the conduct of site operations, personnel monitoring may be performed to establish and document the environment in which field teams have been working. This monitoring will be utilized to comply with the requirements of the REM III Health and Safety Program and with OSHA regulations. Use of cartridge respirators shall be monitored to comply with OSHA and to document compliance with acceptable exposure criteria.

See Section 9.1.3 about sampling to be done for documentation of indoor building concentrations of aniline and methyl bromide.

9.3 MEDICAL SURVEILLANCE PROCEDURES FOR EVIDENCE OF PERSONAL EXPOSURE

All REM III personnel and subcontractors who will be performing field work at the Whitmoyer Laboratories Site will be required to have passed a REM III's medical surveillance examination or equivalent. A release for work will be confirmed by the NUS Corporation CHSS before an employee can begin hazardous activities. The exam will be taken annually at a minimum and upon termination of REM III work. Additional medical testing may be required by the NUS Corporation CHSS in consultation with the company physician and the HSO is an overt exposure or accident occurs, or if other site conditions warrant further medical surveillance. The specific tests that will be employed for a specific site are to be addressed here. As necessary the medical surveillance requirements established by OSHA's Inorganic Arsenic Standard, 1910.1018, may need to be addressed.

300719

SECTION X: SAFETY CONSIDERATIONS FOR SITE OPERATIONS

10.1 GENERAL

All field sampling will be performed under the level of protection described in Section VIII. In this section all non-monitoring, safety-related procedures will be described for each site operation. Such procedures may include special additional clothing to be worn, respirator specifications and modification, special safety equipment such as harnesses and non-sparking tools, need for backup teams, etc. Special considerations should also address provision for heat and cold stress, presence of water, sewer and electrical lines or underground conduits, sampling handling requirements, etc.
(See discussion in HS-1.01)

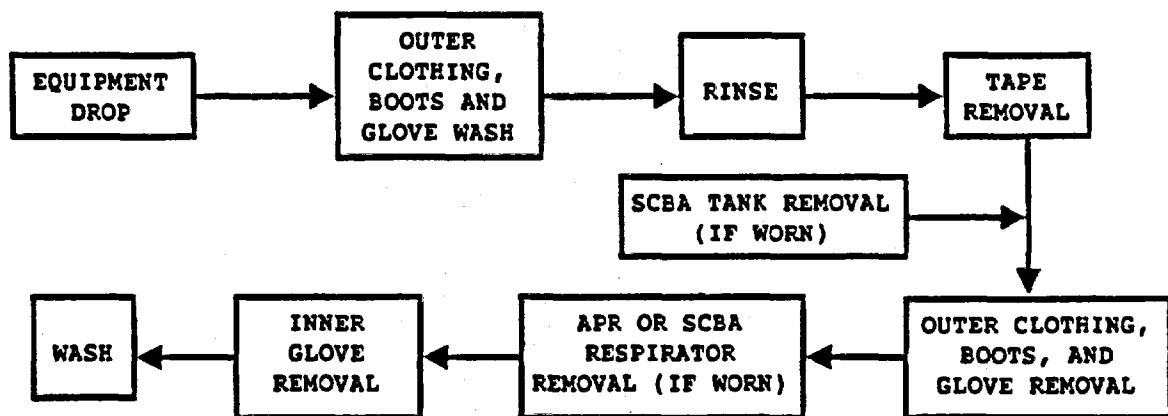
- All drilling/excavating requires a check (plus documentation) for underground utilities.
- No drilling within 20 feet radius of overhead power lines.
- No hand to mouth contact is permitted during activities.
- No facial hair, which interferes with mask fit.
- No flames or open fires will be permitted onsite.
- No working outdoors will be permitted during electrical storms.
- All subcontractor personnel will be responsible for employing safe operating procedures and complying with OSHA while drilling and conducting related field activities.
- All REM III Health and Safety requirements plus the contents of this HASP must be followed by all applicable site workers.
- Work Areas must be partitioned off by some method to combat unauthorized entry.

300720

SECTION XI: DECONTAMINATION PROCEDURES

All personnel and equipment exiting the exclusion zone shall be thoroughly decontaminated. Figures should be used to illustrate the decon procedures for personnel and portable equipment for the various protection levels indicated in Section VIII. Heavy equipment, if utilized for operations where it may be contaminated, will have prescribed decontamination procedures to prevent hazardous materials from leaving the site. They may include excavating a shallow pit to collect waste cleaning solution and screens, set up if required, to prevent the spread of air contaminants. The pit will be cleaned, wastes disposed of, filled in, and covered with clean soil when its use is terminated. The surface area of the pit shall be sufficient to accommodate the washwater generated by the largest piece of machinery. Equipment needed may include a stream generator with high pressure water, empty containers, screens, screen support structures, and shovels. (Describe layout and include figure)

1. Equipment drop
2. Outer clothing, boots and glove wash
3. Rinse
4. Tape removal
- 4a. SCBA tank removal (if worn)
5. Outer clothing, boots and glove removal
6. APR or SCBA respirator removal (if worn)
7. Inner glove removal
8. Wash



300721

SECTION XII: ADDITIONAL WORK PRACTICES

The attached OSHA poster will be prominently displayed in the field office trailer.

SECTION XIII: DISPOSAL PROCEDURES

All discarded materials, waste materials, or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left onsite. All potentially contaminated materials, e.g., clothing, gloves, etc., will be bagged or drummed as necessary and segregated for disposal. All contaminated waste materials shall be disposed of as required by the provisions included in the contract and consistent with REM III and regulatory provisions. All non-contaminated materials shall be collected and bagged for appropriate disposal as normal domestic wastes.

Disposal methods shall be in accordance with the Field Operations Plan (FOP) accepted by the EPA. This shall include both disposable equipment and decon waste.

300722

SECTION XIV: EMERGENCY PLAN

14.0 As a result of the hazards on site, and the conditions under which operations are conducted, the possibility of an emergency situation developing is very real. An emergency plan is required to be available for use at all REM III Sites.

Various individual site characteristics will determine preliminary action to be taken to assure that this emergency plan may be successfully implemented in the event of a site emergency. Careful consideration must be given to the proximity of neighborhood housing or places of employment and to the relative possibility of site fire, explosion or release of vapors or gases which will impinge on these neighbors. If there is even a remote possibility of any of these occurrences, the Site Manager must coordinate the neighborhood interface with his Regional Manager, the Community Relations Coordinator, the CHSS and the HSM.

Careful evaluation of the above factors have been made by the Site Manager. Based on this analysis, the following action will be taken prior to site activity.

The project HSO will notify all site workers of adequate emergency information and post the phone numbers in the site trailer.

14.1 THE SITE EMERGENCY COORDINATOR IS:

Field Operations Leader	<u>TBA</u>
HSO (Alternate)	<u>Kevin Kenney (J Trepanowski)</u>

The emergency coordinator shall make contact with local fire, police and other emergency units prior to beginning work on site. In these contacts the emergency coordinator will inform the emergency units about the nature and duration of work expected on the site and the type of contaminants and possible health or safety effects of emergencies involving these contaminants. Also at the time the emergency coordinator and the emergency response units shall make arrangements to handle any emergencies that might be anticipated.

300723

Contacts have been (will be) made with the following individuals:

<u>Name</u>	<u>Title</u>	<u>Jurisdiction</u>
-------------	--------------	---------------------

<u>Contacts will be made onsite by HSO or HSO alternate</u>		
<u> </u>		
<u> </u>		
<u> </u>		

The emergency coordinator shall implement the contingency plan whenever conditions at the site warrant such action. The coordinator will be responsible for assuring the evacuation, emergency treatment, emergency transport of site personnel as necessary, and notification of emergency response units and the appropriate Management staff.

14.2 EVACUATION

In the event of an emergency situation, such as fire, explosion, significant release of toxic gases, etc.; an air horn or other appropriate device will be sounded for approximately 10 seconds indicating the initiation of evacuation procedures. All personnel in both the restricted and nonrestricted areas will evacuate and assemble near the Support Zone or other safe area as identified by the emergency plan. The location shall be upwind of the site as determined by the wind direction indicator. For efficient and safe site evacuation and assessment of the emergency situation, the Emergency Coordinator will have authority to initiate proper action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The HSO or Assistant HSO must see that access for emergency equipment is provided and that all combustion apparatus has been shut down once the alarm has been sounded. Once the safety of all personnel is established the Myerstown Fire Dept. and other emergency response groups will be notified by telephone of the emergency. The Site evacuation plan shall be rehearsed regularly as part of the overall training program for site operations.

14.3 POTENTIAL OR ACTUAL FIRE OR EXPLOSION

Immediate evacuation of site (air horn will sound for 10 second intervals) notify local fire and police department, and other appropriate emergency response groups if LEL values are above 25 percent in the work zone or if an actual fire or explosion has taken place.

Fire Department	- 911
Police Department	- (717) 866-5317

300724

14.4 ENVIRONMENTAL INCIDENT (RELEASE OR SPREAD OF CONTAMINATION)

Control or stop spread of contamination if possible. The emergency coordinator should instruct a person on site to immediately contact local authorities to inform them of the possible or immediate need for neighborhood evacuation. If a significant release has occurred, the National Response Center should then be contacted. This group will alter National or Regional Response Teams as necessary. Following these emergency calls, the reporting individual should then notify the SM, CHSS, RM, and HSM.

		PHONE
<u>Myerstown</u>	Fire Department	<u>911</u>
<u>Myerstown</u>	Police Department	<u>(717) 866-5317</u>
<u> </u>	National Response Center	<u>(800) 424-8802</u>
<u>J Trepanowski</u>	SM	<u>(412) 788-1080</u>
<u>M Soltis</u>	CHSS	<u>(412) 788-1080</u>
<u> </u>	RM	<u> </u>
<u> </u>	HSM	<u>(703) 558-7506</u>

14.5 PERSONNEL INJURY

Emergency first aid shall be applied onsite as deemed necessary. Then decontamination and transport the individual to nearest medical facility if needed. The HSO will supply medical data sheets to appropriate medical personnel and complete the incident report designated in HS-1.12.

Hospital	- <u>(717) 273-8521</u>
Rescue	- <u>911</u>

The ambulance/rescue squad shall be contacted for transport as necessary in an emergency. However, since some situations may require transport of an injured party by other means, a hospital route must be firmly identified. During the initial reconnaissance a primary hospital and back-up facility shall be located and route located to and from site with details of the route delineated. A hospital route location map shall also be provided in the HASP as well as conspicuously posted on site.

Primary Hospital Route:

Take route 422W towards Lebanon, PA, get off at the 4th Street exit and make a right at the end of exit ramp. Hospital is on your right (see map that follows).

300725

Backup Hospital Route:

To be determined by the project HSO upon initial visit to site.

14.6 OVERT PERSONNEL EXPOSURE

Include generic first air procedures in this section. Typical response includes:

Skin Contact: Use copious amounts of soap and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention. Eyewash and emergency shower or drench system will be provided onsite at the CRZ and/or Support Zone as appropriate. Eyes should be rinsed for 15 minutes upon chemical contamination.

Inhalation: Move to fresh air and/or, if necessary decon/transport to hospital.

Ingestion: Decontamination and transport to emergency medical facility.

Puncture wound or laceration: Decontaminate and transport to emergency medical facility. HSO will provide medical data sheets to medical personnel as requested (see Section XVI).

Hospital - (717) 273-8521
Rescue - 911

14.7 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the HSO will determine if work can continue without sacrificing the health and safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries
- Potential for cold stress and cold-related injuries
- Treacherous weather-related working conditions
- Limited visibility
- Potential for electrical storms

300726

SECTION XV: AUTHORIZATIONS

Personnel authorized to enter the Whitmoyer Laboratories Site while operations are being conducted must be certified by the NUS Corporation CHSS. Authorization will involve completion of appropriate training courses and medical examination requirements as required by OSHA 29 CFR 1910.10 and review and sign-off of this HASP. All personnel must utilize the buddy system or trained escort, and check in with the Field Team Leader at the Command Post.

1. NUS Corporation Personnel Authorized to Perform Work Onsite:

- | | |
|----------------------------|-----------|
| 1. <u>Kevin Kenney</u> | 11. _____ |
| 2. <u>John Trepanowski</u> | 12. _____ |
| 3. _____ | 13. _____ |
| 4. _____ | 14. _____ |
| 5. _____ | 15. _____ |
| 6. _____ | 16. _____ |
| 7. _____ | 17. _____ |
| 8. _____ | 18. _____ |
| 9. _____ | 19. _____ |
| 10. _____ | 20. _____ |

2. Other Personnel Authorized to Enter Site:

- | | |
|-----------------------------------|-----------|
| 1. <u>ZPMO Personnel</u> | 6. _____ |
| 2. <u>REM III Regional</u> | 7. _____ |
| <u>Personnel</u> | 8. _____ |
| 3. <u>EPA Personnel</u> | 9. _____ |
| 4. <u>State Environmental</u> | 10. _____ |
| <u>Personnel</u> | |
| 5. <u>Police, Fire, Emergency</u> | |
| <u>Personnel</u> | |

300727

SECTION XVI: MEDICAL DATA SHEET

This brief Medical Data Sheet will be completed by all onsite personnel and will be kept in the Command Post during the conduct of site operations. Completion is required in addition to compliance with the Medical Surveillance Program requirements described in the REM III Program Health and Safety Plan. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project Whitmoyer Laboratories

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of Next of Kin _____

Drug or other Allergies _____

Particular Sensitivities _____

Do you wear contacts? _____

Provide a checklist of Previous Illnesses
or Exposures to Hazardous Chemicals _____

What medications are your presently using? _____

Do you have any medical restrictions? _____

Name, Address, and phone number of personal physician:

300728

SECTION XVII: FIELD TEAM REVIEW

Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read and understand this Site-Specific Health and Safety Plan. I will comply with the provisions contained herein.

Site/Project: Whitmoyer Laboratories

Name Printed	Signature	Date

300729

SECTION XVIII: APPROVALS

By their signature the undersigned certify that this HASP is approved and will be utilized at the _____
Whitmoyer Labs site.

Michael S. Yarnall for Kevin Kenny
Health and Safety Officer

03/24/88
Date

John P. Repanowski
Site Manager

4/5/88
Date

Richard C. Gerlach for MHA SOLTS
Company Health and Safety
Supervisor

03/24/88
Date

[Signature]
Company Designated Lead

4/5/88
Date

John C. Janone
REM III Health and
Safety Manager

04-08-88
Date

300730

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

When there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each

citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to \$1,000 for each serious violation and for optional penalties of up to \$1,000 for each nonserious violation. Penalties of up to \$1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than \$10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort. If requested, also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1985
OSHA 2203



William E. Brock
William E. Brock, Secretary of Labor
U.S. Department of Labor
Occupational Safety and Health Administration

Under provisions of Title 29, Code of Federal Regulations, Part 1983.204(c) employers must post this notice for a least 90 days in a conspicuous place where notices to employees are customarily posted.

300731

LIST OF DOCUMENT-INTERLEAVED IMG FILES FOR JOB 6417 REPORT 0001
FILES MARKED WITH AN "*" WILL NOT BE PURGED

NONE

GRAPHICS ERROR PAGE LIST (PAGE NO./ERROR CODE)

39/0008

GRAPHIC REPORT COMPOSITE ERROR: 0008

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